RESEARCH PAPER N°. 3(a)

FEED USE ESTIMATION: DATA, METHODOLOGIES AND GAPS - THE CASE OF CHINA

OCTOBER 2013

AMIS

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Table of contents

List of acronyms

AMIS – Agricultural Marketing Information System
AQSIQ - General Administration of Quality Supervision, Inspection and Quarantine
CAAA- China Animal Agriculture Association
CAF - Chinese Association of Fishery
CFIA - China Feed Industry Association
FAO – United Nations Food and Agriculture Organization
FAPRI - Food and Agricultural Policy Research Institute of Iowa State University
FIO – Feed Industry Office of MOA
IFPRI – International Food Policy Research Institute
MOA - Ministry of Agriculture
MOC - Ministry of Commerce
MOF - Ministry of Finance
NDRC - National Development and Reform Commission
NFASMC - National Federation of Agricultural Supply and Marketing Cooperatives
NGOIC - National Grain & Oils Information Center
NBS - National Bureau of Statistics
SAG - State Administration of Grains
SAIC - State Administration of Industry and Commerce
SAPCR - Surveys on Agricultural Production Costs and Returns
USDA – Department of Agriculture of the United States
WTO – World Trade Organization

1. Introduction

China is now the largest user and importer of feed ingredients in the world with FAO estimating feed consumption of cereals in 2009 at 17 percent of global averages. Over the past three decades, the Chinese economy grew at unprecedented levels as a result of socioeconomic reforms, averaging 9.8% during the period of 1978-2012. Rapid growth in urban and rural incomes have induced a continual shift of consumers' preferences towards high quality food products, including meats, milk and fishery products. Consequently, demand for feedstuffs has grown rapidly as well. This trend has been further enhanced by a changing mode of animal production, characterized by shifts from smallholding production units towards large-scaled commercial operations which use more commercial feed. At present, it is estimated that about half of China's grain output is used for feeding animals along with a large volume of other feedstuffs. Given its large size, China has become a key player in the international feed market and changes in either feed demand or supply have ripple effects in global markets.

However, China's official statistics on both animal production[1] and on feed usage are frequently questioned. This report describes China's statistical system related to animal production and feedstuff utilization, assesses data quality and reviews related methodological issues. On the basis of this analysis, recommendations are made on how to improve estimates of feed supply and demand.

The report is organized as follows. First, China's agricultural statistical system is described with a special focus on highlighting the complexity and the challenges related to deriving sound feed statistics. Then trends in animal production are reviewed using the official statistics and the key factors affecting estimation of feed consumption examined. Section 3 describes available feed resources, provides a profile of developments in the feed sector, and introduces statistical methodologies used to estimate feed use, reviews key gaps, highlights issues of conceptual compatibility, identifies key missing data. The final section consolidates the findings from this case study and proposes some options for consideration for enhancing feed statistics.

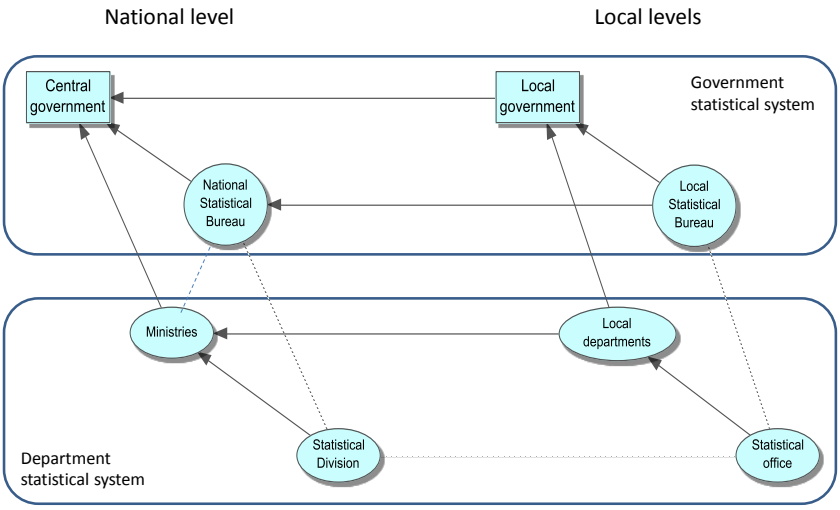
2. China's Agricultural statistical system

2.1 The official statistical system

2.1.1 Institutional setup

As is stipulated under Statistical Law, China established a centralized and unified statistical system and management system which features unified leadership and a decentralized administration. The official statistical system consists of the central and local government statistics offices with the individual departments of statistics shown in Figure 2.1.

[1] In this report, animal production refers to both livestock production and aquaculture production.



Note: The solid lines stand for administrative leadership while dashed lines stand for technical guidance. The left and up arrows indicate major channels of data reporting.

Figure 2.1 China's official statistical system

The government statistical system consists of central and local statistical agencies at the corresponding level of government. The National Bureau of Statistics (NBS) is established under the State Council while local statistical agencies are located at provincial, prefecture (city) and county levels. Township governments have designated officers to carry out data collection work.

The Organization of Rural Socio-economic Surveys is one of the three specialized survey-taking institutions under the NBS, which has the primary responsibility to collect agricultural statistics via nationwide surveys. The government statistical system is responsible for organizing and implementing national or local level surveys, as well as processing/disseminating these national or regional statistics. The statistical agencies of local governments are under the dual leadership of governments at the local level and statistical agencies at higher levels with the latter primarily exercising leadership from the perspective of statistical operations. As a matter of concern, the independence of these local statistical agencies cannot always be fully ensured. Local statistics need to be approved by the corresponding local governments prior to reporting to upper level statistical agencies while personnel working with local statistical agencies are directly responsible to local governments and are thus subject to various influences of local leaders.

The department of statistical systems is constituted by statistical branches of various departments under either the central government or local authorities. Its major function includes the organization and coordination of statistical work of the departments concerned, as well as the statistical work of enterprises and institutions within the jurisdiction of the department concerned. At the national level, the NBS is responsible for examining, approving and managing plans and schemes for statistical surveys to be implemented by other departments as well as administering and coordinating statistical survey questionnaires designed by various departments. Nevertheless, inter-department communication and coordination in statistical work is always problematic as

every ministry has its own preferred approaches for collecting statistical data, complicated by vested interests with regard to disclosure and concealment of certain information.

Institutional links pertaining to official statistics currently involve departments in the central government who have specific responsibilities for collecting, compiling and reporting agricultural statistical data. These institutions and their responsibilities include[2]:

- Ministry of Agriculture (MOA): agricultural production and the rural economy;
- Ministry of Commerce (MOC): agricultural marketing and trade;
- National Development and Reform Commission (NDRC): macro-level management of agricultural sector with special focus on maintaining stable markets and price stability;
- State Administration of Grains (SAG): administrative management of grains purchases, distribution, storage, imports and exports under state plans;
- Ministry of Finance (MOF): state-funded agricultural development projects;
- State Administration of Industry and Commerce (SAIC): overseeing agricultural marketing activities and firm behavior;
- General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ): enforcing food and feed quality standards;
- National Federation of Agricultural Supply and Marketing Cooperatives: supplying farm inputs and marketing of certain agricultural produce (fibers, fruits and tea).

2.1.2 Agricultural data collection methods used by the NBS

National agricultural census

China first introduced national agricultural censuses in the mid-1990s. The first census was conducted in 1996 with technical assistance from the FAO. Decennial agricultural censuses have since then been implemented regularly. The NBS is assigned responsibility for carrying out this census in collaboration with other related state bodies. The second agricultural census was conducted in 2006. Selected indicators at national and provincial levels are published by the NBS. The findings did help to identify discrepancies in some key production statistics, such as livestock production (see Appendix Table A1 and A2)[3].

Crop statistics

Until the end of the 1980s, China's crop production statistics were derived primarily from a reporting system through which the information recorded by grass-root production units and then

[2] Several other state bodies also generate statistics related to agricultural sector or rural economy. The China General Administration of Customs records and compiles import and export statistics for all goods. The Ministry of Land and Resources is responsible for the planning, administration, protection and rational utilization of natural resources, including cultivated land and marine resources. The Ministry of Water Resources is responsible for rational utilization of water resources and conservation of water and soil while the Ministry of Environmental Protection supervises and manages the prevention and control of environmental pollution. Although these functions are highly relevant to agriculture, the statistical work undertaken by these state bodies are regarded as general rather than sector-specific.

[3] It should be noted that the results of national censures did not resolve all disputes on statistical data, such as that related to cultivated land area.

reported to upper level governments through a bottom-up approach. It was recognized that this arrangement led to artificially biased statistics due to incentives for lower level governments to exaggerate their performance or conceal their wrongdoings. To solve the problem, the NBS adopted in the 1990s a method of statistical inference to derive estimates of crop production, with which crop yields were actually measured with sample plots by NBS's local officials independently and crop output were calculated based on the surveyed yields times corresponding areas. Other methods of surveillance, such as remote sensing, may also be used as reference information for purposes of cross-checking.

Although this approach is well designed from a statistical perspective, its implementation in practice has some problems. It is known that not all production units can be covered in the crop survey due to technical, financial or institutional limitations. Moreover, the NBS needs to consult provincial governments and related ministries to verify the statistics. It is during this process that provincial governments and other ministries may attempt to influence the process through defending their preferred results. The released data are based on mutual acceptance, achieved through negotiations. Occasionally, however, data with significant differences are released in different statistical publications, such as national yearbook and provincial yearbook. Data inconsistency may exist even within one yearbook[4].

Livestock statistics

The arrangements for collecting animal production data differ from methods used for estimating crop production. Larger production units above specified size criteria are required to report their production statistics (mainly animal numbers in stock and sales of livestock products), while smallholding units are surveyed using random sampling methods. The slaughtering weights for different types of animals are obtained from surveys of slaughter houses. The total figures for meat production, on a regional and national level, can then be statistically inferred. Effective implementation of the statistical work is, however, critically affected by several factors: 1) China's animal production units are much more diversified in scale than that of crop production units; 2) the livestock industry has been undergoing a rapid process of restructuring; 3) there exist substantial regional variations in livestock production systems and technologies; and 4) small-scale livestock systems are still prominent as a means of production. These factors lead to difficulties in designing and implementing livestock surveys[5]. It is recognized that problems of overestimating meat output is highly related to structural changes in animal production systems. After liberalizing livestock markets in the mid-1980s[6], animals were allowed to be sold multiple times (for instance, breeding

[4] For instance, Heilongjiang's soybean planting area in 2010 was reported as 3.55 and 4.48 million hectares in the national and the provincial statistical yearbooks, respectively (NBS, 2011a; NBS, 2011b). While the data of Heilongjiang's provincial soybean production in 2010 were consistently reported as 5.85 million tons in both the national and the provincial statistical yearbooks, the summary output of prefectural level units was 9.77 million tons, 67 percent higher than the reported provincial total (NBS 2011b, Table 11-14).

[5] Information obtained from personal communication indicates that the NBS uses only the level of rural incomes as a sampling framework. This may not be a good choice for statistical inference of farm production due to production systems having no close linkages to rural income levels. On the other hand, it is too costly to maintain separate sampling frameworks for different farm products, leading to issues of representativeness of the survey sample.

6 During the period when China implemented central planning, animals produced by the then agricultural collectives were allowed to be sold only to designated state or quasi-state rural agricultural marketing agents. This arrangement was relaxed gradually in the early 1980s when rural reforms gave partial decision rights to rural

animals were sold to fattening enterprises) and thus the amounts of animals sold and meat produced could be over-estimated.

Food consumption statistics

Currently, food consumption data come primarily from the NBS's large-scaled urban and rural household sample surveys[7]. The surveys are designed to collect a wide range of information related to household income, expenditure, consumption, etc. Data on per capita consumption of selected food items at national and provincial levels are released in regularly produced publications (e.g. Yearbook of China Rural Household Survey and Yearbook of China Urban Household Survey). The rural household survey covers information of farm resources, production and sale of major products, and farm inputs purchased as well. With respect to grains, the rural household survey form includes production, sale, selected usages and on-farm stock, but the data released publicly are rather limited.

By design, stratified random sampling is used in these surveys. However, implementation of the surveys is frequently challenged with problems of non-cooperation, leading to biases in sampling and inaccuracy in the recorded data. Although data from these sources are frequently used as the basic information to derive aggregate consumption of certain food products, consistency cannot be guaranteed. The recognized major flaws include gaps in away-from-home consumption data (Wang and Fan, 1999; Yuan, 2001), varying retail weights of differentiated products (He and Tian, 2000) and frequent revisions of the statistical definitions of data collected.

Recognized information gaps

With regard to agricultural statistics, the current work of data collection and reporting by the NBS is not conducted within a framework of market supply-demand balance. While data of production and trade are relatively complete, utilization data are clearly inadequate. Apart from incompatibility and incompleteness of the food production and consumption data, statistics of utilization by industrial sectors and stocks held by various entities have not been collected in a systematic way.

2.1.3 Agricultural data collection methods used by the MOA

Setup of the statistical system

Within the national system for agricultural statistics, the Ministry of Agriculture (MOA) plays a major role. In terms of methods used, the statistical work done by the MOA can be classified as sample surveys and regular statistical reporting. While the design of the surveys and the norms of implementation need to be reviewed and approved by the NBS, the activities are carried out by

households via adoption of the household production responsibility system. As one of the reform measures, the government liberalized markets for animal products in 1985, although the state-owned commercial channel prevailed for a while. Since then, producers have been allowed to sell their products to not only commercial buyers, but also other animal production units, particularly for further fattening.

[7] In 2012, the total numbers of surveyed urban and rural households were 65,981 and 73,750, respectively. However, these samples are proportionally quite small in comparison to an estimated 200 million households located in either urban or rural areas.

statistical branches or officials in agricultural departments from central government down to township government (MOA, 2013a and 2013b). MOA carries out its own surveys to collect some specific data, such as prices of selected agricultural products, animal breeding stock, etc. While there exist overlapping activities related to statistics and data collection between MOA and NBS, the information collected is usually complementary although occasionally incomparable and inconsistent.

Sample surveys

The sample surveys intend to mainly monitor short-run changes in agricultural production and markets. By design, a stratified random sampling method is used when implementing sample surveys, where samples include counties, villages and households. The raw data at household level are collected by assigned investigators, drawing from 1) either records required to be kept by sample households; or, 2) from actual measurement in the field, from which data of sample villages are calculated. Subsequently, county and provincial data are then inferred statistically by the corresponding agricultural departments. Thus, the statistical validity of data collected relies critically on the method of choosing surveyed units. Verified data are reported upwards. Similar to the NBS's agricultural production surveys, the sampling method used by MOA prioritizes grain production, leading to the "unrepresentativeness" of the samples for deriving production data of other products. In fact, the MOA and the NBS produce separate estimates for some agricultural statistics, but the data released publically can only come from NBS. In MOA's survey designs, drawing supplementary samples is recommended as the first choice to cope with the problem. If this is still insufficient, data can be corrected through a method of "adjustment factor", a term which implies that local officers have some freedom to choose their own ways to derive statistics.

Regular reporting

Decentralized government bodies (such as local Agricultural Bureaus) have the responsibility to regularly report statistics to higher government bodies. Consequently, regular agricultural reporting, e.g routine data collection, is data collected through a bottom-up approach. By design, regular reporting covers all types of economic entities engaging in agricultural production with research plots managed by research institutions as an exception. The data include conditions for agricultural production, predicted and the actual situation of agricultural production, as well as the performance of the rural economy with indicative indicators including estimated output of major products, the value of agricultural production, and rural incomes. In the case when the agricultural department is incapable of gathering its own data, statistics from other departments can be used. The data are reported on monthly, quarterly or annually basis, depending on specific needs. These data are used primarily for administrative purposes with restricted access.

Statistics of feed industry

MOA is assigned the responsibility for monitoring the overall management of the feed industry, although production of manufactured feed products is undertaken on a commercial basis, typically by the private sector. The statistics of the feed industry are collected through a system of reporting,

covering all types of production units of feed products, additives and feed-making machinery. The system of data reporting has evolved over time. According to the latest reports, the information collected include the general situation of feed enterprises, capacity of output, production of major products, major raw inputs used, business performance, and prices of feed products (MOA, 2012). The raw data from enterprises are compiled by local branch of agricultural department and moved upwards through the administrative system.

2.1.4 Agricultural data collection activities by other government bodies

Survey on agricultural production costs and returns

The Chinese government started surveys on agricultural production costs and returns (SAPCR) in the early 1950s aimed at gathering reference information for determining state procurement prices of important agricultural products, including cereals, oilseeds, fibers, selected horticultural products, and animal products. The survey was interrupted several times and then resumed regularly in the 1980s. Institutionally, the SAPCR is now managed by the Department of Prices within the NDRC. The SAPCR is unique in that it is the only source which provides input-output information of a specific production process with some details8. The SAPCR reports outputs and inputs in both quantities or values for individual products on a unit area (for crops) or on a by head basis (for animals). By contrast, NBS or MOA's statistics have only aggregates of inputs used by whole agricultural sector. The survey covers major field crops, selected horticultural products, animal products and fishery products. Summary results of the survey are published as a specific yearbook (Compilation of Production Costs and Returns of Agricultural Products) but only in recent years.

In terms of methods, the SAPCR obtains information from undertaking sample surveys in major production regions, which vary depending on the individual product. The samples are chosen using a method similar to stratified sampling in that sample counties are selected first and sample production units are then drawn. Given the fact that the SAPCR is designed for deriving information about impacts of price changes, the samples are traditionally chosen using a rather vague classification of "good", "fair" and "poor", with the criteria for sampling based often on ranking of grain yields or rural economic development. The statistical properties of the SAPCR are challenged on the basis of small sample sizes, conceptual vagueness of data collected, time inconsistency caused by frequent changes in statistical concepts, etc.

At present, the animal products covered by SAPCR include pigs, beef cattle, dairy cattle, meat sheep and goats, wool sheep, broiler, layers, and aquaculture. For some products, the surveys are further broken-down by production size. The reported data include live weight in sales or in ending stock, value of production, labor inputs and imputed costs, value of material inputs by major cost items, usage of "fine feed" and "grains". In the SAPCR, "fine feed" includes grains, beans, manufactured feed products, wheat brans, oilseed meals and additives; and "grain feed" is

8 The SAPCR survey aimed at assisting state procurement price determination in the central planning stage, during which prices were usually set at levels covering all material costs plus reasonable returns to producers' own resources. After agricultural markets were largely liberalized, the information is used mainly to assess returns to producers under the current market and policy environment.

measured in terms of "traded grain", which is calculated as the sum of the weight of rice, wheat and corn actually used, converting weights of paddy rice, wheat flour, rice bran, soymeal, potato and sweet potato using prescribed conversion factors, and weights of grain ingredients in manufactured feed products (NDRC, 2012).

Superficially, it seems apparent that information of feed conversion ratios is already embedded in the SAPCR in that the survey compiles information on both the animal output (gross weight or incremental weight) and weights of fine feed and grain feed. It is from these two indicators from which feed conversion ratio can be calculated. While it is possible to calculate aggregate consumption of feed using animal output from NBS and the feed conversion ratios from SAPCR, the results are unreliable given 1) the inaccuracy in animal production statistics; 2) definitional vagueness as well as; 3) statistical unrepresentativeness of the feed conversion ratios; and, 4) difficulties in deriving representative weighting schemes on the basis of collected feed conversion ratios among production units in different scales and among different regions.

Statistics on grain & oil processing

The statistics on grain and oil processing are collected by the State Administration of Grains (SAG) which is affiliated to the NDRC. The SAG is assigned responsibility for managing affairs related to grain marketing, including the responsibility for collecting grain processing statistics. The statistical work done by the SAG is based on a bottom-up reporting system. The reported information includes type of enterprises, technical capacity, outputs of products, raw materials used, financial results, etc. So far the data are not released publicly in a systematic way.

Feed processing is one of the activities covered by the SAG. The related statistics include output of feed products and selected by-products used as raw materials for feed production. However, the SAG's statistics cover only those enterprises linked to grain and oil processing industries. In comparison with the 2010 statistics from the MOA, the number of enterprises covered was much smaller (about one-seventh), but the output of feed products accounted for a much large share (about two-third). It should be noted that SAG and MOA carry out their own feed statistical work independently. The SAG's survey covers mainly large feed firms, while that of MOA includes many small enterprises. There is overlapping coverage.

2.1.5 Institutional collaboration in data collection

Under current regulations, all other government bodies must submit their statistical programs to the NBS for approval. The data collected by these state bodies are used mainly for implementing their respective mandates. The data may be released publicly either on an *ad hoc* basis or regularly but the data must be acknowledged as non-official statistics, nor representative, nor as authoritative as NBS statistics. In general, the data from such sources are narrowly focused on specific objectives with varied coverage and are thus supplementary to NBS's statistics.

As previously indicated, there exist institutional overlaps in data collection. For instance, both MOA and NBS undertake data collection on grain and animal production. While the NBS derives data

based through sample surveys, the MOA's data are collected using the traditional bottom-up reporting schemes. However, official data of production statistics come only from the NBS, although typically a consensus is needed among the concerned government bodies before data release[9].

Meanwhile, several government bodies collect price information using their own methodologies which lead to noticeable differences in reported data. Data reported by the NBS usually have a long time lag. Although other government bodies may generate certain information in a more timely manner than the NBS, they shouldn't be allowed to release the data publicly. This is due to the fact that each government body focuses only on data priorities under their own jurisdiction without effective channels to share information. It is more importantly recognized that, under the current arrangements, it is difficult to ensure consistency of the data, resulting in discrepancies between national statistics and regional statistics and among data of production, consumption, trade and stocks. Although a substantial amount of data are collected in aggregate, it is unlikely to generate a clear comprehensive understanding of specific products, due to the segmented system of data collection.

2.1.6 Major obstacles to the collection of official statistics

To a large extent, the deficiencies in reported official statistics can be attributed to institutional complexities, rather than the lack of resources or technical capacity. As previously mentioned, under current institutional structures, district or local level officials may purposefully misrepresent, or overstate, statistics to the central government in order to demonstrate their "superior performance" or to excuse failures. Enterprises have limited interest in providing accurate statistics to the government for a variety of reasons. Similarly consumers and farmers also lack incentives to cooperate with statistical officers. It is understandable that, given the large number of entities involved in agricultural markets and the great diversity of farming systems in China, designing and implementing statistical surveys on animal and feed industries is very challenging.

In the past, the Chinese government compiled balance sheets of certain farm products, including grains. However, the data were used primarily for planning and policymaking purposes without public dissemination. The work was discontinued after the implementation of economic reforms which challenged the ability of traditional data collection systems to monitor the rapid changes in economic systems and institutions. Recognizing the importance of such data and systems, the Chinese government resumed joint studies with foreign institutions, such as the US Department of Agriculture, and collaboration in compiling balance sheets for certain farm products. In recent years, the government also sponsored domestic related research projects. However, the progress seems to be slow due to a range of factors not the least of which relate to budgetary constraints. Thus far no results have been released publicly.

[9] Data differences between NBS and MOA, and between central government and local governments are well known. However, released official data are only from NBS withMOA reporting on data not covered by NBS.

2.2 Non-official statistical work

2.2.1 Statistical activities by quasi-public institutions

Non-official statistics related to animal production and feed sector are also produced by some quasi-public institutions and private consulting firms. Such data producers have their specific objectives and use their own approaches to collect and compile information. It is apparent that none of them have adequate financial and human resources to conduct nationwide statistical surveys in a way comparable to the NBS. More importantly, they have no administrative authorities to require micro-entities to provide them with information. To a large extent, collection of statistics has to be done on basis of willingly cooperation of concerned micro-entities, leading to problems of the representativeness of the sample coverage. In addition, these organizations typically have a short history and their statistical work is still in the process of evolution. It is understandable that the data from such sources are plagued by problems of inconsistency, related both soundness in statistical concepts and data collection methods.

Currently, several industrial associations are the quasi-public sources of statistics related to animal production and feed sector. These institutions are commonly derived from government branches which are still responsible for their respective mandates. They are also assigned certain administrative responsibilities in coordinating activities of enterprises, collecting and sharing industrial information, etc. Normally, membership in such associations consists of large producers (enterprises) and thus the coverage and representativeness of the information collected is open to question. Besides, their staffing and technical competences are not strong enough to undertake data collection, analysis, and documentation in line with endorsed statistical principles. Although data from such sources usually include some information unavailable from the official statistical systems, the quality continues to be open to challenges. The data may also not be compatible with the official statistics nor with information from other related associations.

With respect to animal production statistics, the China Animal Agriculture Association (CAAA) annually issues the China Almanac of Animal Husbandry in collaboration with Department of Animal Husbandry of MOA. Apart from the provision of the official statistics on animal production, such as livestock numbers and slaughter, this source includes information on the evolving structure of the industry, by major species. However, the categorization, or definition, of production units by size is not always consistent and the information sometimes doesn’t match the official statistics shown in the same publication (see Appendix Table A3).

The China Animal Agriculture Association: What is its role?

China Animal Agriculture Association (CAAA), set up in 2001, is an affiliation formed at the national level with membership from enterprises, public institutions and individuals involved in animal husbandry and related industries. It is a non-profit social body with a legal entity. Among its various roles in the animal agriculture industry, CAAA provides services, coordination, right protection and management.

The objectives of the CAAA include the integration of industry resources, standardization of industry ethics, protection of industry interests, development of industry activities, industry information exchanges and promotion of industry development.

Quoted from CAAA website http://www.caaa.org.cn/en with minor revisions.

Similar to CAAA, the Chinese Association of Fishery (CAF) compiles and annual releases the China Almanac of Fishery in collaboration with Department of Fishery of MOA. Although the almanac provides considerable qualitative information, the quality and usefulness of its statistical data is limited. Usage of feed products for aquatic production is often mentioned in the document.

The China Feed Industry Association (CFIA) annually compiles the China Almanac of Feed Industry in collaboration with the Feed Industrial Office of MOA. This almanac is edited more consistently than the abovementioned two publications and the data it provides are useful in that they are not available elsewhere. However, it coverage of feed statistics is limited to the availability of different types of feed products, including manufactured compound feed and additives. Thus far, the almanac does not cover statistics of raw materials used by feed industry, such as cereals, energy crops, etc nor by smallholding units. As a consequence, accurate estimated of feedstuff usage cannot be derived from the provided information.

The China Feed Industry Association: Role

The China Feed Industry Association (CFIA) is a social group which was approved by the State Council in 1985. It plays an important role as a bridge between the government and enterprises, social groups and personnel who are engaged in the feed industry field. Its purpose is, under the guidance of the government, is to assist the government to manage and monitor the industries, to set up relationships among industries as well as between the industry and government, to maintain the legal rights and interests of members, to serve the membership and businesses, and to promote the development of China feed industry, drawing on and fostering innovations in science and technology.

The CFIA's main role is to help government and industries by providing basic linkages for the government to enact policy, through the propagation of basic knowledge within the feed industry, extend science and technology achievements and management experience, facilitate trade cooperation and science and technology exchange, offer information services, organise academic seminars, compile and publish relevant papers and magazines, develop relevant public welfare information, reflect members' opinion and requirement, and provide advice to the government.

Quoted from CFIA website http://www.chinafeed.org.cn/intro/5.htm with minor revisions.

With respect to grain market information, the National Grain & Oils Information Center (NGOIC) also plays an important role. The Center is administratively linked to the State Administration of Grains. However, it generates revenue from its information services. The products of this center include balance sheets of major cereals and oilseeds, which are supplied/sold on a commercial basis. In the compilation of the balance sheets, the center uses production data and trade statistics from the NBS and China Customs as input which feed into the collection of estimates on other items, such as feed usage. In doing so, and through their access to certain internal information from SAG, the center has a comparable advantage in providing a unique data set. It also has close linkages with companies and is thus able to obtain their perspectives on market developments

2.2.2 Commercial supply of agricultural statistics (through consulting services)

Deficiencies in official statistics offer business firms good opportunitities for profits through the provision of consulting services and supportive data. The product coverage of such consulting firms varies from the provision of a few industry-specific products/data sets to a wide range of information on farm produce. The services are provided exclusively on a commercial basis. However, with limited manpower and financial resources, such consulting firms (e.g. Beijing Orient Agribusiness Consultants Co., Bric Global Agricultural Consultants Co. etc.) normally use official statistics on production and trade as the base for deriving other missing components of the balance sheets, such as food and feed consumption and stocks. Special field surveys (usually focused on selected regions or enterprises) are often carried out to derive first-hand observations

and needed information. Some data are purchased from suppliers, such as monthly imports and exports data provided by the Customs Authority. They often enter into collaboration with large firms in specific industries to gather information and generate analysis on sector specific market development. The market analysis and data by international institutions (such as FAO and USDA) are also used as references Modelling analysis may also support market analysis. On the basis of these additional information, balance sheets are derived through a logically consistent framework, e.g. through a market clearing process, although the validation of the data continues to problematic. This contrasts with NBS and MOA data on the individual components of the balance sheets which aren't analyzed within the overall market context. Compared with quasi-public associations, the market analyses by private consulting firms are done in a more professional way, typically using a more solid theoretical and empirical basis. On the other hand, these estimates are disadvantaged by limited access to both private information and classified official information.

2.2.3 Major obstacles to the non-official statistical work

Under the current institutional structure, undertaking statistical analysis by non-official entities in China faces considerable difficulties. Data collection by quasi-public institutions is, in fact, part of the official statistical work, although additional data may be obtained to respond to their mandated requirements. However, as previously indicated, these institutions are often not well equipped for undertaking systematic statistical work and their visions are narrowly defined. It is unlikely that they will play a growing role as data providers in the future.

On the other hand, commercial data services are at present bound by a wide range of restrictions. Institutionally, commercial firms are not allowed to carry out large surveys without approval by the government, which limits the ability of commercial consulting firms to derive first-hand data. Such providers are also limited by their analytical and staffing capacities. Given the magnitude and diversity in China's agriculture, it is unlikely that firms with limited staff are capable of gathering data in a comprehensive way. In such a context, the existing consulting firms can only assume the role in undertaking analysis of official data, identifying likely discrepancies of the data, and deriving some missing information based on their knowledge.

2.3 Sources of statistics on animals and feedstuffs

As we have seen, China produces a wide range of statistics related to feed and animal sectors by various governmental or quasi-governmental bodies. However, under the current institutional setup, each government body assumes responsibility for collecting statistical information within its jurisdiction without considering the whole market. When all these data put together, logical inconsistencies become apparent. Table 2.1 shows the sources, nature of the data and mentioned the related quality problems for statistics on feed and animals.

Table 2.1 Major data sources related to feed and animal sectors

Statistics	Source	Nature of data	Availability	Methods of raw data collection	Recognized major problems
Production of cereals and soybean	NBS / MOA	Official	Annually published in various yearbooks	Reporting by scaled units & sample surveys for smallholdings	Areas of cultivated land (so the yield or even production) are subject to reporting errors.
Numbers of animals in stock by types	NBS / MOA	Official	Annually published in various yearbooks	Reporting by scaled units & sample surveys for smallholdings	Numbers of animals are subject to survey errors.
Number of animals sold by types	NBS / MOA	Official	Annually published in various yearbooks	Reporting by scaled units & sample surveys for smallholdings	Numbers of animals are subject to survey errors, possibly subject to double counting.
Outputs of animal products by types	NBS / MOA	Official	Annually published in various yearbooks	Reporting by scaled units & sample surveys for smallholdings	Output data errors are related to the errors in numbers of animals.
Scale distribution of animal production units by animal types	CAAA / MOA	Unofficial compilation	Annually published in almanacs	Reporting by scaled units	The data are derived based on both reporting of large units and estimation. Grouping by scale varies over time. There exist inconsistencies with the official production statistics.
Food consumption of cereals and soybeans	NGOIC/ Consulting firms	Unofficial estimates	Monthly and annually supplied to buyers with limited release in public channels	Estimates based on available information and knowledge	Basic data and estimation methods are not transparent and thus unverifiable.
Feed consumption of cereals and meals	NGOIC/ Consulting firms	Unofficial estimates	Monthly and annually supplied to buyers with limited release in public channels	Estimates based on available information and knowledge	Basic data and estimation methods are not transparent and thus unverifiable.
Production of manufactured feed products by types	CFIA	Unofficial compilation	Annually published in China Almanac of Feed Industry	Reporting by scaled units	Coverage is limited to scaled commercial feed mills. Data are subject to reporting errors.
Feedstuffs used for production of manufactured feed	CFIA	Unofficial compilation	Reported annually in a piecemeal way in China Almanac of Feed Industry	Reporting by scaled units & estimates	Coverage is limited to scaled commercial feed mills. Data are subject to reporting errors.
Per head usage of fine feed by type of animals and by operating scale	NDRC	Regular sample surveys	Annually published in Compilation of Agricultural Production costs and Returns	Sample surveys by types of production units	The survey is not based on statistical sampling method; The data are subject to recording errors. The amount of fine feed is an aggregate of feed grains, by-products and manufactured feed products.

Consumption of cereals and soybeans for other usages	NGOIC/ Consulting firms	Unofficial estimates	Monthly and annually supplied to buyers with limited release in public channels	Reporting by scaled units & estimates	Basic data and estimation methods are not transparent and thus unverifiable.
Changes in stocks of cereals and soybeans	NGOIC/ Consulting firms	Unofficial estimates	Monthly and annually supplied to buyers with limited release in public channels	Estimates based on available information and knowledge	Basic data and estimation methods are not transparent and thus unverifiable.
Exports and imports of cereals, soybeans, feedstuffs, animal products	General Administration of Customs	Official	Annually published in yearbook	Data compiled based on custom clearances	Data are subject to reporting errors. Smuggling activities result in under-estimation of both exports and imports.
Agricultural census on farm resources, population and employment, production and market conditions, rural livelihood, organizational forms.	NBS	Official	Decennially conducted with summary information released at national and provincial levels.	Data compiled from survey forms	Processing of data is not fully transparent with restrained accessibility.

2.4 Methodological issues in estimating feed grain components of the cereal balance sheets

The utilization of grains for feed became a hotly debated issue only after the mid-1980s when rural reforms brought about significant increases in grain output, with maize production nearly doubling since 1990, from 96 million tons to an estimated 208 million tons in 2013 (Table A5). As a result, optimizing structures of agricultural production began to become a priority by both national planners and researchers. However, although the government recognized the growing importance of feed grains, no effective efforts were made in collecting feed grain statistics using a systematic and consistent approach. Consequently, all of the data on feed grains are estimated by different individuals with their own conceptual definitions and methods.

In general, estimation of feed grain uses follows either a demand approach or supply approach (Zhou and Tian, 2003). While the demand approach estimates the amount of feed grains required by multiplying the outputs of animal products through estimated feed-meat conversion ratios, the supply approach calculates the amount of grains available for feeding animals. Application of either of the approaches often encounters some difficulties.

With the demand approach, aggregate feed grain demand (AFD) is calculated using the formula below:

$$AFD = \sum_j \alpha_j \times O_j \qquad (1)$$

where α is feed converting factor, O is output of livestock product, and subscript j denotes animal types.

It is apparent from formula (1) that the final calculations rely critically on accuracy of output statistics of animal production and feed conversion factors. As discussed above, although the official statistics on animal outputs are available, the data are subject to systematic errors as shown in Table A1 and A2. The data of feed conversion ratios for different animals by size of operations can be obtained from production cost surveys by the NDRC. However, the parameters obtained from this source have apparent faults in terms of unrepresentative sampling and ambiguity in concepts as previously discussed. Besides, NDRC data provide no corresponding information on prevalence of different kinds of animal-raising practices. While feed conversion ratios can be found from many other sources, such as experimental reports and scientific journals, there exist significant discrepancies (Zhou and Tian, 2003). While this fact is understandable given the great diversity of China's practices for animal raising, it is certainly a warning signal that the results critically depend on the parameters included in the calculations.

With the supply approach, aggregate feed grain supply (AFS) is calculated as:

$$AFS = \sum_i \left(Q_i - DHC_i - IU_i - NEX_i - \Delta Stock_i\right) \qquad (2)$$

where Q is grain output, DHC is direct human consumption, IU is industrial utilization, NEX is net export, $\Delta Stock$ is stock variation, and subscript i denotes grain types.

The formula (2) is essentially based on supply-demand balance framework, where aggregate feed grain supply is derived as the residue of supply deducting all non-feed utilizations. While production and trade data are relatively reliable through survey or customs data, the data of direct human and feed consumption as well as industrial utilization are simply unavailable and need to be estimated. In particular, although it is well known that the amounts of grain used as industrial raw materials is growing very rapidly, the data are only estimates and highly influenced by the differentiated interests of enterprises and regional government in one side and the central government on the other side. The data on changes in state stocks are more difficult to access due to political sensitivities. Therefore, although the results of such exercises were frequently published, they are all subjective estimations by nature.

2.5 Comparison with international sources of the information

China's grain market situation has been constantly monitored by selected international organizations and trading partners. At present, the FAO (including AMIS) and USDA compile China's balance sheets of major grains, oils and animal products independently. Being an international organization, the FAO ensures collaboration in the area of statistics with the Chinese government although it formally adopts China's official data. By contrast, the USDA is perhaps more independent and, consequently, attempts to verify China's statistics and to derive its own estimates of missing data. Whether the effort is successful, remains an open question.

In Appendix Table A4 and A5, statistics of pork and corn are used as examples to compare data from the NBS, FAO, OECD and USDA. The NBS reports only statistics of production and thus the conceptual consistency of the data is not ensured. The FAO reports production data in a timelier matter than those of commodity balances, leading to some minor differences. AMIS also reports supply-demand balances, limited to only recent years and selected key commodities[10]. The OECD works closely with the FAO on projecting medium term outlooks for global agricultural markets using official Chinese statistics. Meanwhile, the USDA's production, supply and demand datasets (PS&D) are comprehensive in terms of products and country (economy) coverage and logically consistent in terms of methodology applied.

It is apparent from Table A4 that the USDA still use China's official production data as the essential basis for deriving balance sheet of pork. In fact, the USDA did not make any adjustment for the data prior to 1996 even though over-reporting was well recognized. The FAO did make corrections to China's pork production data in its production dataset, probably in line with findings from China's national agricultural censuses. However the same data in its commodity balance sheet were still based on the NBS data, showing inconsistency in data treatment. Considering the fact that import and export data are quite accessible and reliable, errors in production data generate errors in estimates of domestic consumption. Although the reported pork consumption data from FAO, USDA and OECD are highly similar in terms of both magnitudes and trend of change, they are certainly only estimates.

[10] It should be noted that these include China's official production figures plus FAO estimates of consumption and stocks.

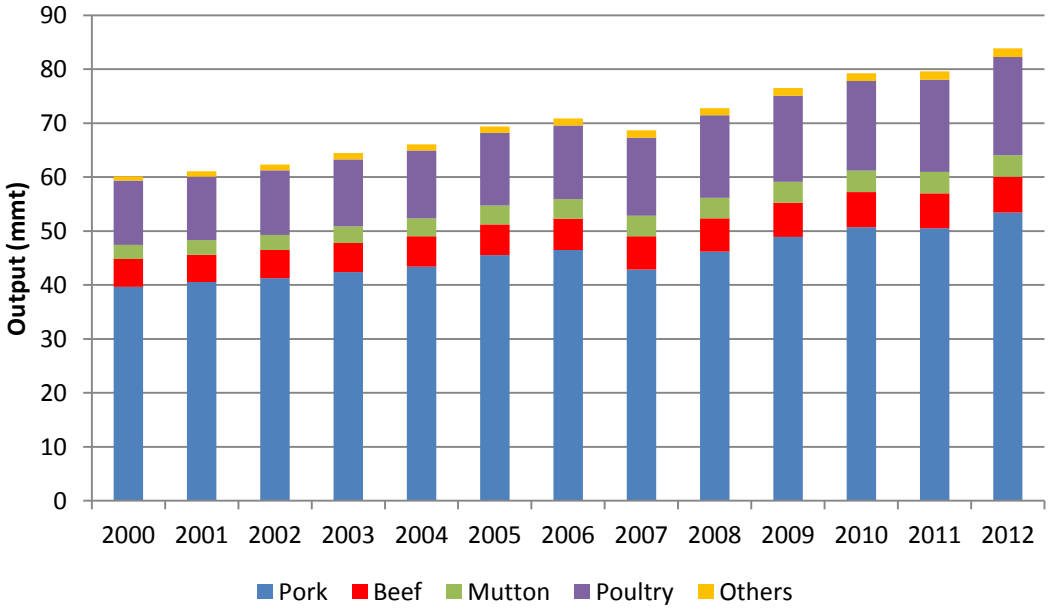
It is also apparent that both FAO (including AMIS) and the USDA rely on NBS production data as the benchmark information to derive China's corn balance sheet. As revealed from the data in Table A5, the production data from all sources are essentially the same. However, the derived feed consumption data have notable differences among the three organizations. Similar to the data of pork, FAO made corrections to China's feed consumption in line with the revised animal production data. By contrast, the USDA kept its early estimates, although this meant internal inconsistency between data of animal production and feed utilization. It is also apparent that the feed consumption data of USDA and AMIS both are of low precision and largely guestimates.

3. Growth and structural change in animal production

3.1 Growth of animal production

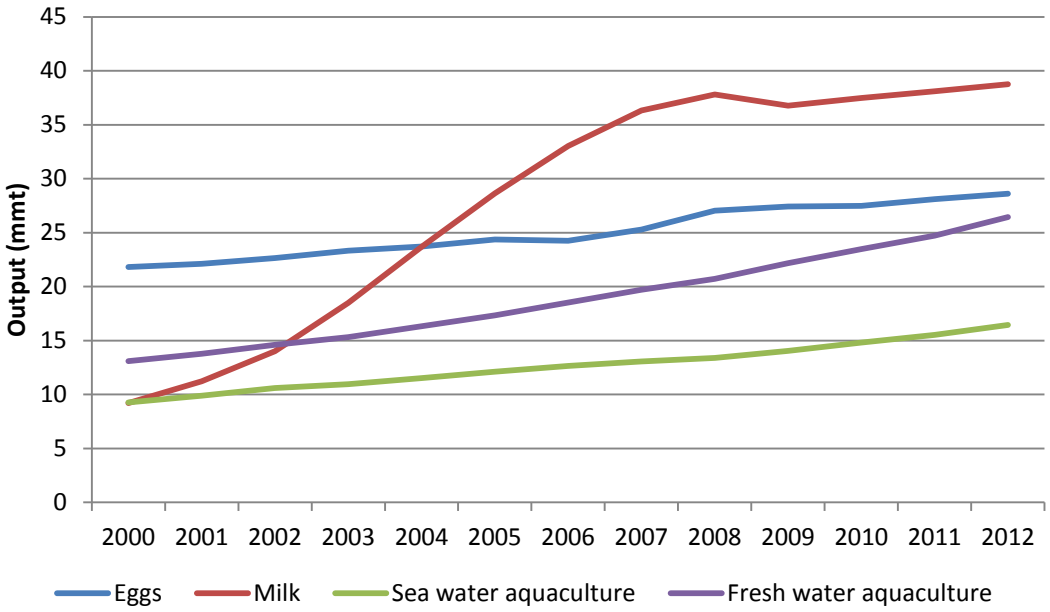
Induced by growing demand for quality food products, China's livestock and fishery production expanded rapidly during the past decade (see Figure 3.1 and 3.2). While outputs of beef, mutton, poultry meats and fishery products rose steadily, the growth rate of pork production witnessed considerable variability related to severe animal diseases in 2006. Growth of milk production was the strongest among the listed products, rising by about four times during the period. However, dairy production leveled off after 2008 when the Melamine scandal occurred, influencing milk consumption.

Figure 3.1 Growth of meat production



Data source: NBS (2013).

Figure 3.2 Growth of eggs, milk and aquaculture



Data source: NBS (2013).

While the strong growth in animal production is certainly true, the actual levels of output for a wide range of animal products is open to debate. Inconsistencies were noted primarily from observed large discrepancies between the growth of per capita consumption and per capita output[11]. Several studies (e.g. Zhong, 1997; Lu, 1998; He and Tian, 2000) addressed the issue. Over-reporting of production was confirmed in the first national agricultural census conducted in the end of 1996. The government adjusted downward the 1996-97 production statistics for different products while keeping the previous reported data unchanged (see Appendix Table A1 and A2). The same situation occurred in the second national agricultural census conducted in end of 2006. The official production statistics were adjusted downward again based on results of the national census. However, adjustments and revisions back to the year 2000 were made this time. Therefore, it should be recognized that China's animal production statistics are comparable only for the period starting from 2000.

3.2 Structural changes in animal production

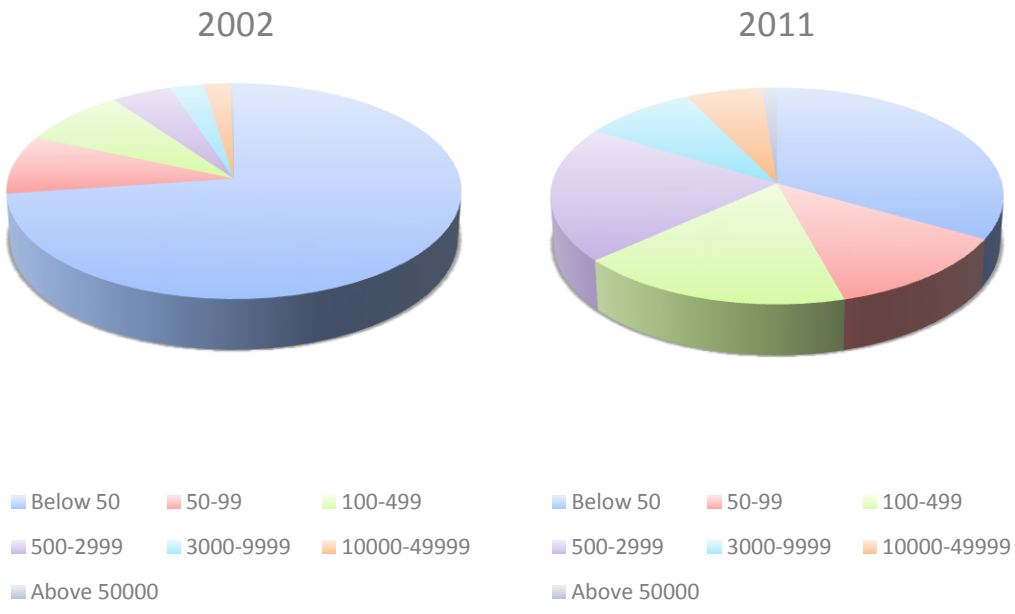
Over the past two decades, China's animal production underwent a process of rapid intensification. The major driving forces include growing demand for quality products by consumers, rising opportunity cost of rural labor, and shifting preference of rural households away from backyard animal production. In anticipation of promising market opportunities, private sector investment began to support large scale animal production units, frequently with encouragement from governments at different levels. Some village enterprises also transformed into large-scaled

[11] Such discrepancies can be checked with data in Appendix Table A6. Using the data of populations and per capita pork consumptions, the total consumption in 1985 was 12.6 million tons, corresponding to 76% of reported output in the year. The amount rose to 15.2 million tons in 1995, representing 42% and 53% of the output before and after adjustment. The calculated share remained below 50% in recent years. Such large discrepancies cannot be fully explained by difference in carcass weight for production and retail weight for household consumption.

agribusinesses. The WTO accession escalated this process by introducing competition in the trade arena through a phased in reduction of import tariffs. In the meantime, vertical and horizontal integrations led by agribusinesses took place. Contract production between large agribusinesses and smallholders became popular in China's animal sector. In the context of this transition, while some animal-raising units moved from backyard operations into specialized feedlots, many others may have simply exited the industry.

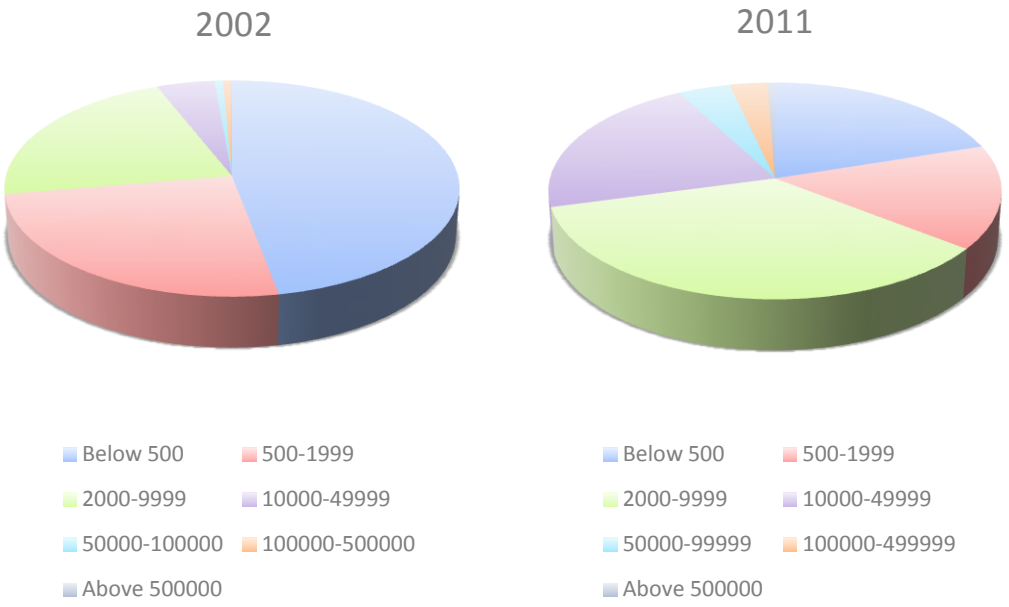
The China Animal Agriculture Association began to collect information of animal production operations by size, starting in the mid-1990s. However, this work relies very much on data reported by local governments, and was not fully reliable. Different ranking criteria were used to group operations by size, leading to the incomparability of data in different years. While the accuracy of the data is subject to question, the general trend of rapid intensification in animal production, however, is undisputed. Figure 3.3 depicts the extent of intensification of animal production by animal types in 2011. It is apparent that productions of all animal types have intensified to varying degrees. Intensification in beef cattle production[12] is the slowest.

Figure 3.3 Changes in scale structure in animal production between 2002 and 2011

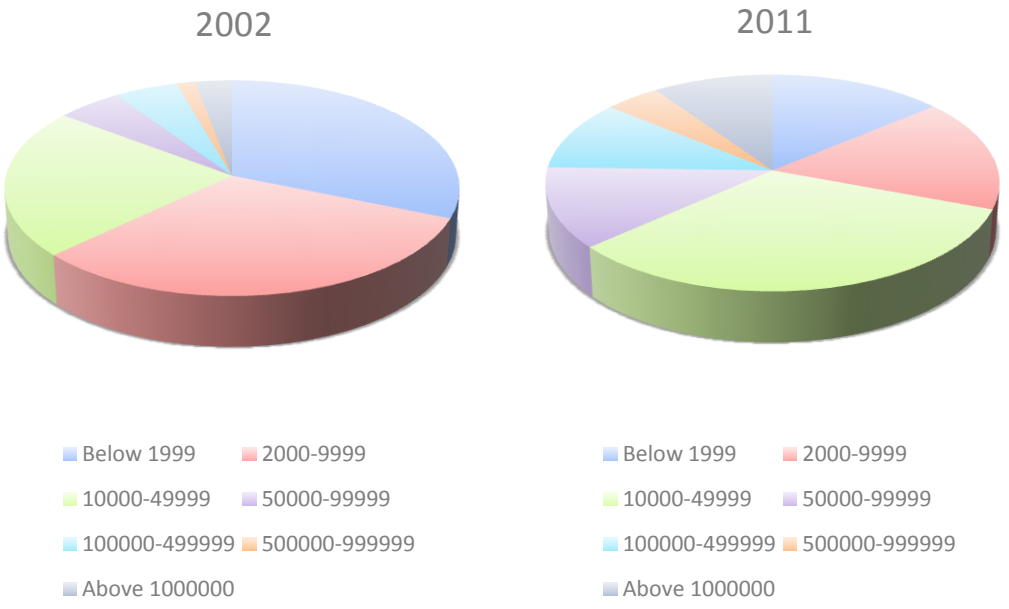


a. Pigs

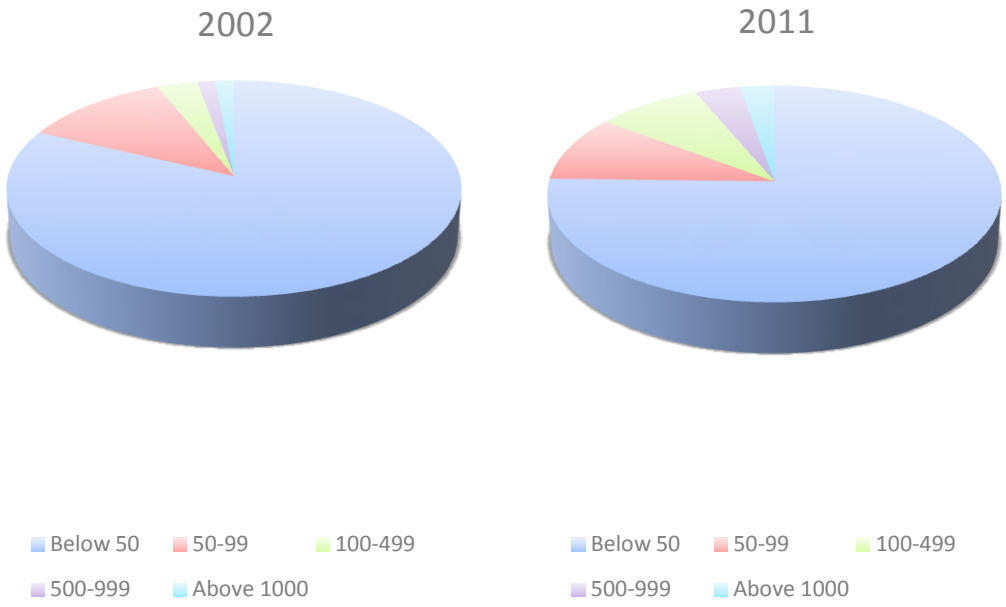
[12] Intensification of sheep and goat production is also slow as indicated by available information from the same source. Due to data incompletion, no graphs are drawn here.



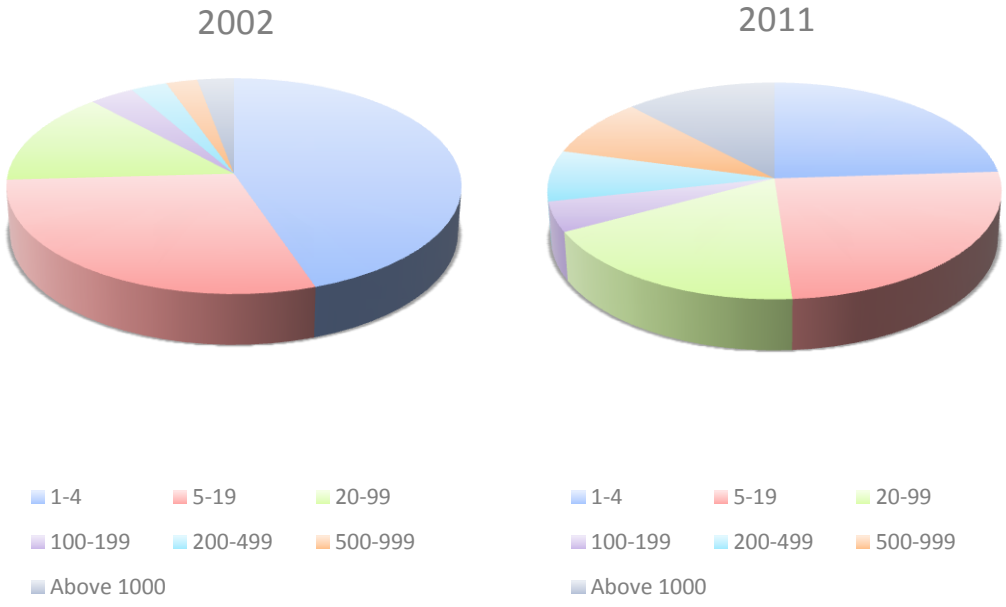
b. Chicken (layers)



c. Chicken (Broilers)



d. Beef cattle



e. Dairy cattle

Note: The scale is measured with number of animals sold for pig and broilers and number of animals in stock for layers, beef cattle and dairy cattle.
Date source: CAAA (2012).

Intensification of animal production has both benefits and problems. By adopting advanced technologies and management, the larger enterprises are, in principle, more able to prevent animal diseases and to produce quality products. It is also likely that increasing operating size may result in reductions of transaction costs. On the other hand, environmental problems associated with scaled production units differ from that associated with smallholding systems and require different approaches and solutions. Also, the business performance of intensive production systems is more

sensitive to changes in prices of feedstuffs and products than the traditional backyard systems.

It should be noted that there exist large regional variations in the structure and mode of animal production, which are determined by resource endowments, climate and market conditions. In general, pig and poultry production is highly concentrated in regions with large supply of feedstuffs derived from crop production and feed processing units. By contrast, production of ruminant animals is relatively concentrated in regions with adequate pastures. While intensive feedlots are well developed in several coastal provinces, backyard animal production still prevails in remote areas. Consequently, it is a difficult task to find representative parameters of feed conversion ratios.

3.3 Feeding efficiency

The information from SAPCR shows that composition of feedstuffs and feed conversion ratios vary greatly not only for different animals, but also for the same animals in different sizes of operations. In general, the larger the operation, the higher the share of "fine feed" cost, and the higher the feed conversion ratios defined in either "fine feed" or grain (see Table 3.1)[13]. Such outcomes are caused to a large extent by the fact that those less intensive units (particularly the backyard system) can use more fully various scattered feedstuffs, such as cooking wastes, grasses and leaves, etc.

Table 3.1 Feed conversion ratios in pig production by types of operation in 2011

	Cost share of fine feed	Fine feed-conversion ratio	Grain conversion ratio
Backyard	93.7	3.03	2.13
Small scaled	98.8	3.10	2.22
Medium scaled	99.1	3.10	2.23
Large scaled	99.6	3.08	2.24

Source: Calculated using data from NDRC (2012). The cost share of fine feed is defined as share of fine feed cost in total feed cost.

On the other hand, all types of operation are reflecting similar trends of increased use of "fine feed" and grain, including those in backyard systems (see Figure 3.4). Such a pattern of change can be attributed mainly to rising labor costs and improved supply of commercially available feed products.

It should be recognized that the feed conversion ratios vary notably among different regions, determined by availability of feed resources as well as climate conditions. Table 3.2 shows degrees of variations in feed grain conversion ratios in pig production among surveyed provinces in 2000 and 2011. The figures suggest that large variations existed in both the past and present. Less intensive production systems had larger variations as such production operations were more able to access scattered, on-farm non-grain feedstuffs. It seems, however, that the variations have narrowed over time due perhaps to the common trend of intensification. It is clear that the national mean feed conversion ratios can be affected by changes in regional distribution, changes in modes

[13] Explanations on "fine feed" and "grain" used in the SAPCR can be found in section 2.1.4.

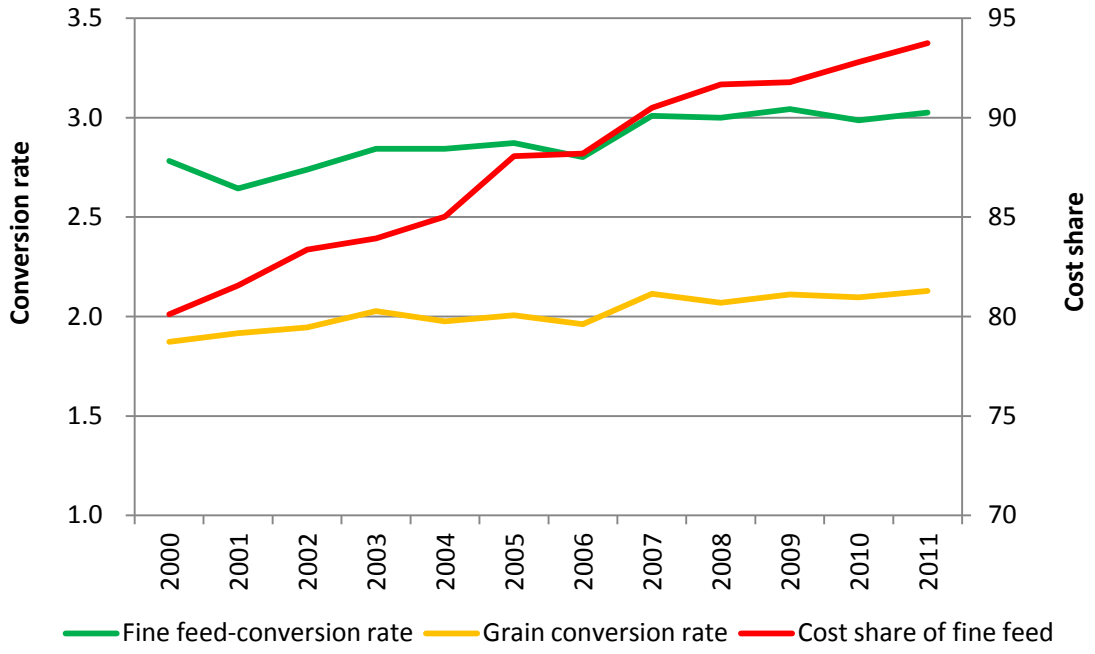
of production, and changes in technology.

Table 3.2 Regional variations in feed grain conversion ratios in pig production

	2000				2011			
	Min	Max	Mean	CV	Min	Max	Mean	CV
Backyard	0.97	2.63	1.87	0.26	1.62	2.59	2.13	0.11
Small scaled	1.03	3.05	2.07	0.27	1.67	2.55	2.22	0.09
Medium scaled	1.71	3.68	2.42	0.17	1.98	2.56	2.23	0.06
Large scaled	1.69	3.61	2.48	0.18	1.97	2.62	2.24	0.08
Total	0.97	3.68	2.20	0.25	1.62	2.62	2.21	0.09

Note: Calculated using data from NDRC (2012). CV denotes coefficient of variation.

Figure 3.4 Changing pattern of feeding practice by backyard system in 2000-2011



Note: The figure is drawn using data from NDRC (2012).

4. Growth and structural change in feed sector

4.1 Available feed resources

In China, major feed materials include coarse grains, low quality food grains, by-products of grain and oil processing, kitchen wastes, some sewages derived from food industrial processing, edible straws and leaves (Tian and Chudleigh, 1999). In the early 1990s, the amount of grains used for feeding animals was relatively small. Usages of energy-intensive and nutritionally balanced feed products have risen steadily since then, leading to rapid growth of feed grain consumption.

Thus far China has not conducted any national feed resource surveys. As a result, the available

data are all subjective guesstimates without compatible concepts, coverage and methods of calculation. With continued development of technology in both agricultural production and agro-food processing, the nutritional content of those traditional feedstuffs has changed and new types of feedstuffs are emerging, leading to difficulty in calculating available feed resources and their nutritional values based on the early parameters.

Over time, China's cultivated land area has declined continuously, although the central government restricts the diversion of farm land to non-agricultural purposes[14]. It is thought by some feed industry experts that China still has large amounts of underutilized energy and protein feed resources, mainly in forms of various food processing by-products and low quality oilseed meals. For instance, China produces large amounts of cottonseed and rapeseed annually, from which the protein meals are not fully exploited. China also has potential to increase supply of tuber crops for feed. However, considering the fact that China's animal production systems are intensifying rapidly, it is unlikely for such scattered and usually low nutritional feed resources to be adapted as important feedstuffs, especially when cheap feed materials are available from the world market. In other words, growing dependence on feed grains will be unavoidable.

As mentioned above, China's statistics on feed use of grains are not systematically collected and reported. Although some consulting firms are increasing documenting their estimates within supply-demand balance sheets, their reliability is not verifiable. In general, such information is helpful for understanding trends in product usage rather than the actual levels of usages. Table 4.1 shows some of the estimate provided by Bric Global Agricultural Consultants Co. and by the NGOIC. It can be seen that the estimates of feed corn from the two sources are quite similar in terms of both level and trend. It is not the case, however, for rice and wheat. Compared with the feed corn data in Appendix Table A4, the estimates by the Chinese data providers are notably lower than those reported by the USDA and AMIS. The discrepancies are large enough to be taken as warning signals to data users.

[14] The accuracy of China's cultivated land areas is also a question. After the first national agricultural census, the total area in 1996 was adjusted upward from 95.5 million hectares to 130.0 million hectares. The NBS did not update its reported 2008 data (121.7 million hectare) till 2013. On December 30, 2013, the NBS released the data in end of 2009 as 133.4 million hectares based on results from the second national investigation of land carried out during period of 2007-2009.

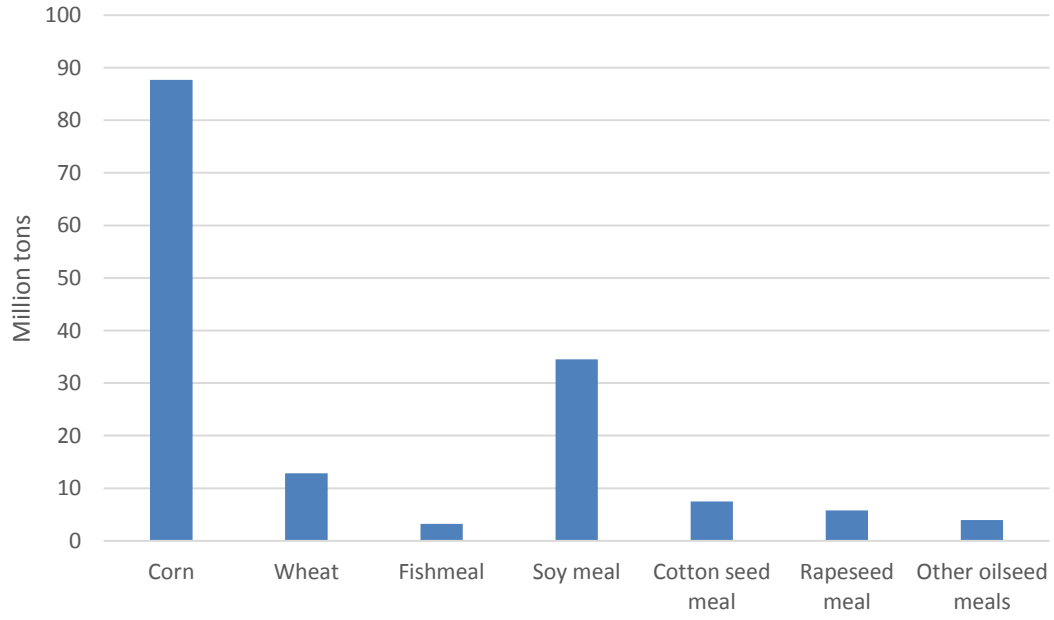
Table 4.1 Estimates on consumption of major feedstuffs (000 tons)

Year	Paddy rice		Wheat		Corn		Wheat bran	Soybean
	Bric Co.	NGOIC	Bric Co.	NGOIC	Bric Co.	NGOIC	Bric Co.	Bric Co.
2000	8100	NA	6000	NA	87450	NA	23543	180
2001	8000	NA	5800	NA	90080	NA	23250	200
2002	8036	NA	6000	NA	91880	NA	23175	210
2003	8036	NA	5800	NA	91900	NA	23625	220
2004	8273	NA	4000	NA	92000	NA	23250	230
2005	8509	23850	3500	6900	93500	NA	23200	250
2006	8746	22700	5820	6800	96000	NA	23225	250
2007	9382	16600	6800	13500	94800	90000	23275	260
2008	9566	15000	6500	9700	96800	92800	23275	260
2009	9627	15500	5000	10500	105800	105000	23288	265
2010	9811	16300	6500	13500	109000	107800	23153	300
2011	10000	16180	16000	23000	112000	116000	23349	301
2012	10220	NA	20000	NA	115000	NA	23073	300

Source: Data from Bric Co. were obtained through personal communication; data from the NGOIC were cities from Cheng (2013, page 174-176).

The Feed Industry Office of Ministry of Agriculture (FIO) attempted to compile data of raw materials used as inputs into feed manufacturing over the recent years (FIO, 2012). The reported amounts of corn and wheat as shown in Figure 4.1 differ slightly from that in Table 4.1. The FIO data cover only qualified feed manufacturers and thus should be smaller than the estimates by Bric Co. While the number of corn is consistent with this expectation, wheat figures are clearly contradictory.

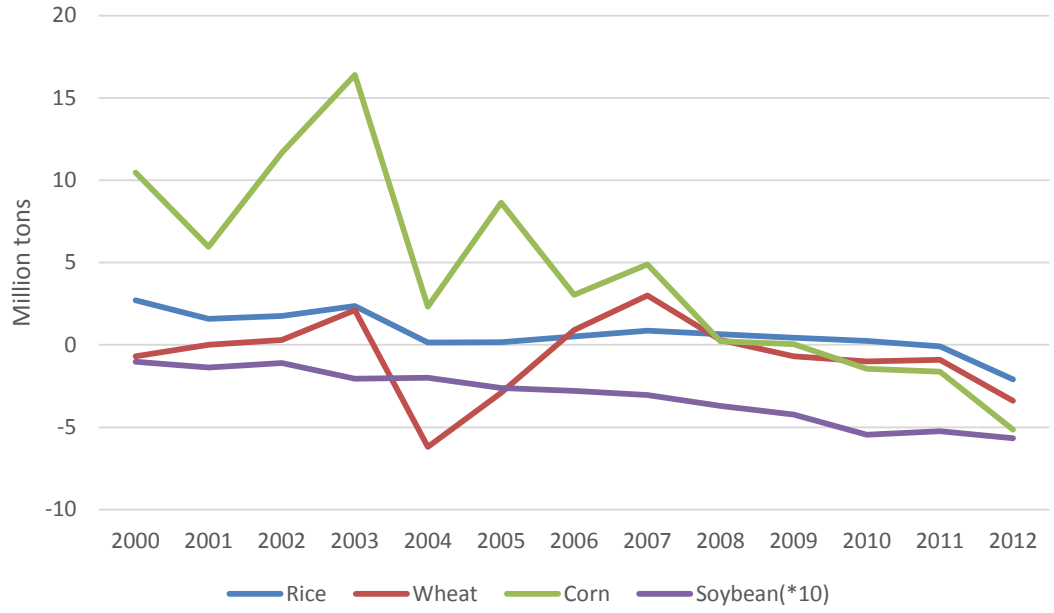
Figure 4.1 major feedstuffs used in 2011 by feed industry



Data source: FIO (2012).

Although China's supply of grains has risen continuously, its domestic demand for grains has grown faster than production, driven by mainly for animal feeding and for industrial processing (Cheng, 2013). In recent years, China has been transformed into a net importer of grains, oilseeds and other feedstuffs (see Figure 4.2). On the other hand, China's trade position in soybean meal reversed from a net importer to net exporter as China operates some of the largest global soybean crushing facilities in the world. Meanwhile, China increased imports of animal fodder and forage products as well as DDGS. Such a pattern of trade is likely to continue and the volumes may increase even further. Therefore, foreign trade is increasingly becoming a key component in China's supply-demand balances of cereals, oilseeds and feedstuffs and the quality of trade statistics becomes an issue. Given the long border between China and neighbouring countries, smuggling activities are not easy to control as witnessed in the rice trade with some Southeast Asian countries, thus adding further complexity in deriving feed consumption data.

Figure 4.2 Changes in net trade positions of cereals and soybean



Data source: Ministry of Agriculture (2013).

4.2 Growth and structural change in grain production

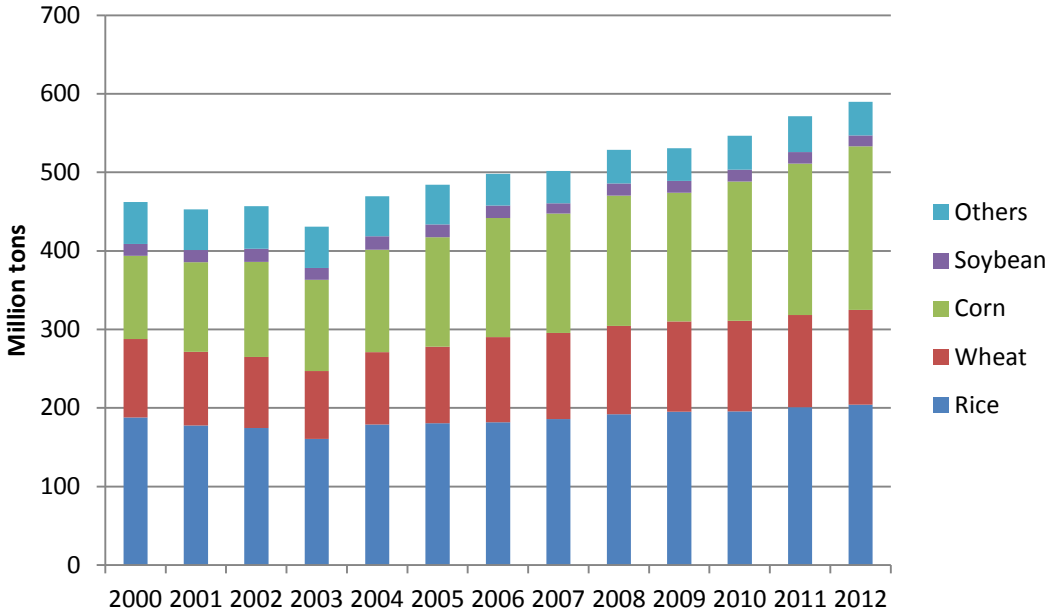
The development of feed sector in China has been closely influenced by not only growth and structural adjustment of animal sector, but also by government food security policies. To-date, the Chinese policymakers have placed grain self-sufficiency as a top priority in the national food security strategy[15]. A wide range of policy instruments have been used to promote grain production in order to avoid "over-dependence" on the world market. Although it has well recognized that the growth in demand for grains are driven by feeding animal requirements, the applied policy

[15] The Chinese government set a target of achieving basic self-sufficiency in grains (95%) in the mid-1990s. This target has been repeatedly emphasized in various official documents and reports. For instance, the statement of 2013 central economic work conference (held in Beijing during December 10-13, 2013) addressed that China must ensure basic self-sufficiency in cereals and secure absolutely supply of food grains.

instruments made no appropriate differentiation towards food demand and feed demands for grains (Tian, 2013).

In responding to the sharp rises of food prices in the mid-1990s, the Chinese government put in place a series of measures to promote grain production, such as raising state procurement prices, increasing state investments in agricultural infrastructure, and enhancing responsibility of local governments on grain production. As a result, China's total grain output rose notably during the late 1990s, leading to short periods of over-supply. To cope with the situation, the government revised policies from emphasizing quantity to quality. The production of high yielding, high quality grains was encouraged as was a focus on high profitability. Grains of inferior quality were phased out from state purchase at guaranteed prices. Meanwhile, large-scaled land retirement program was implemented for conservation. Grain output declined in subsequent years with production hitting a low in 2003. Although the WTO accession intensified international competition, the large decline in grain areas and production were caused by mainly domestic factors, namely the market-driven shifts in production towards high-valued crop products combined by the policy-driven retirement of cultivated land for environmental conservation initiated in 1999. However, the continued decline of grain production was interpreted as a food security warning signal by policymakers and, as of 2004, a series of policy actions were enacted to re-stimulate production; these policy measures included direct subsidies to grain producers, subsidies for improved seeds, subsidies to stimulated purchases of farm machinery, comprehensive subsidies on farm inputs, and a phasing out agricultural taxes. From 2004 on, China's grain output rose continuously (see Figure 4.3). Corn production increased most rapidly as it is both the most important feed grain and the major raw material for industrial processing. Over the period of 2000-2012, the share of corn in total grain output rose from 22.9 percent to 35.3 percent (NBS, 2013). The growing share of corn in overall grain output resulted from both yield improvement and area expansion induced by rise of relative prices.

Figure 4.3 Changes in grain production[16]



Data source: NBS (2013).

The Chinese government traditionally priorities securing food grain supplies. As a result, corn and other coarse grains were mainly planted to marginal lands or early-maturing varieties were used in order to avoid competition with other, more high quality, staple food crops. As a result, China's yields of coarse grains were notably lower than those of major exporting countries. For instance, China's corn yield, during period of 2010-12, was about 20 percent lower than that of Argentina and about 35 percent lower than that of the US (FAO, 2013). Although the recent hikes of corn prices created incentive for farmers to devote more effort to corn production, the yield gap cannot be easily narrowed. It is likely that China's imports of corn for feed will grow steadily over time, leading to growing dependence on imported feed grains for development of national systems of animal production. Faced with such a prospect, the Chinese government introduced a program of "grain-saving livestock development" for the period of 2011-2020 (MOA, 2011)[17]. The program placed a high emphasis on increasing production of animals that are less dependent on grain feed, such as ruminant animals, rabbit and goose. Fully utilization of various non-grain feed resources

[16] In the Chinese statistics, grains cover not only cereals, but also seeds of beans and tubers. Output of fresh tubers is converted to grain output at a ratio of 5:1. It should be noted that rice is accounted in weight of paddy in China's production statistics and in milled weight in grain marketing statistics (called traded grains). As for grain market analyses by non-official data providers, both concepts may be used without clear explanation.

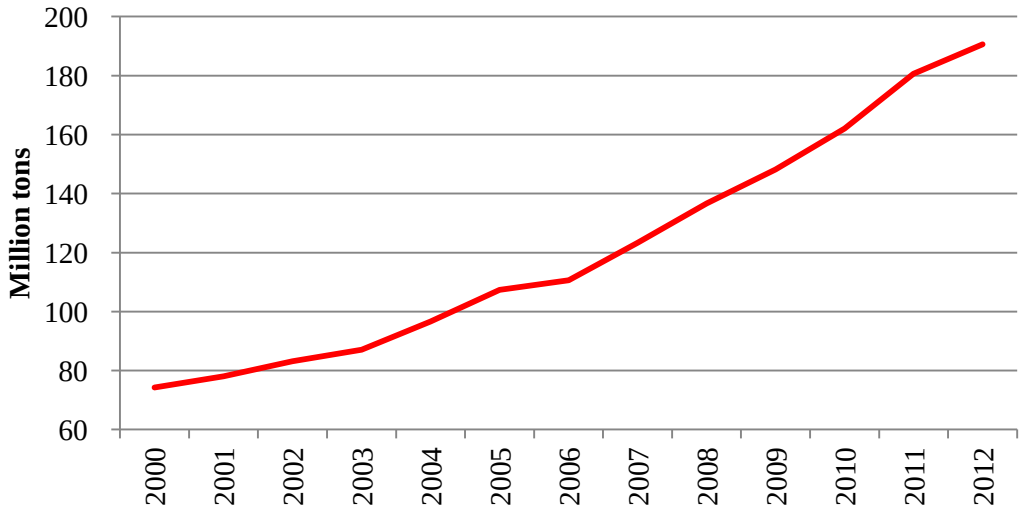
[17] In September 2011, the government promulgated the "Twelfth Five-year Plan for the National Development of the Animal Husbandry Industry (2011-2015)", which expressly stated that the development objective of the animal husbandry industry during the Twelfth Five-year Plan period was to remarkably improve the quality of the animal husbandry industry. Standardized large-scale farming would be the key development focus during the Twelfth Five-year Plan period. By 2015, the proportion of large-scale livestock farming in China will increase by 10% to 15% and the percentage of farms nationwide with over 100 dairy cows will exceed 38%. The document also emphasized that China will continue to increase financial support in key animal husbandry areas such as grassland ecology, breeding of fine livestock and forage grass production. At the end of 2011, the government announced the "Development Plan for the Grain-saving Animal Husbandry Industry in China (2011-2020)" yet again. The Plan stated that the dairy industry is a key component of the national grain-saving animal husbandry strategy, and that better infrastructure for original and fine breed farms for grain-saving livestock and poultry (including dairy cattle) was needed to improve proprietary breeding capabilities. It also emphasized that the government will continue to increase support for the dairy industry and expand the scope of subsidies to fine breeding.

were also addressed.

4.3 Development of the feed industry

Traditionally, given consistent short supply of food grains, Chinese peasants used all sorts of on-farm feedstuffs to raise animals and feed grains where usually only supplemental. The situation changed gradually since the mid-1980s when economic reforms led to significant increases in both consumers' incomes and grain outputs. This created the essential conditions for the emergence of a modern feed industry. In the 1990s and 2000s, in responding to the trend of intensification in animal production, the national feed production capacity expanded continuously. By 2012, total output rose to 190.6 million tones (see Figure 4.4). During the period of 2000-2012, production of manufactured feed products grew at an average annual rate of 8.2 percent (CAAA, 2013). By contrast, the average growth rate in the same period was only 2.4 percent for all meats products and 2.1 percent for eggs (NBS, 2013). Production of milk increased at a much higher rate (12.1 percent), and occurred before 2008.

Figure 4.4 Growth in production of manufactured feed

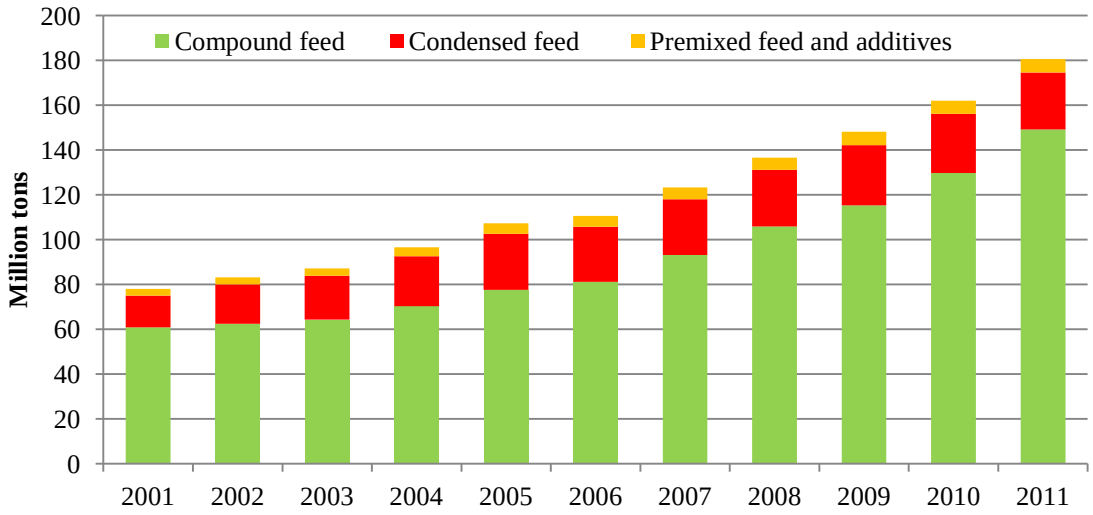


Source: China Almanacs of Feed Industry 2012.

Figure 4.5 depicts the composition of manufactured feed products. In China, premixed feed and additives are quite important for many smallholding units and small-scaled feedlots who mix such products with on-farm feedstuffs to produce nutritionally more balanced feed for saving costs. The production capacity of premixed feed and additives expanded more rapidly during 1991-2005. By 2005, the share of these two types of feed products accounted for 27.7 percent of the total output. In recent years, many smallholding units exited from animal production due to factors like rising opportunity cost of family labor, pursuing better living conditions, and the uncontrolled outbreaks of animal diseases[18]. The intensive production units use mainly compound feed products purchased from merchants or produced at their own feed mills. The share of premixed feed and additives declined steadily after 2006. By 2011, the share reduced to only 17.4 percent.

[18] Changes in number of pig-raising units can be used as an example. According to data released by CAAA (2012), the total number (including smallholding units and enterprises) declined from 105.4 million in 2002 to 57.9 million in 2011. As discussed in section 3.2, the number of scaled units rose during the period.

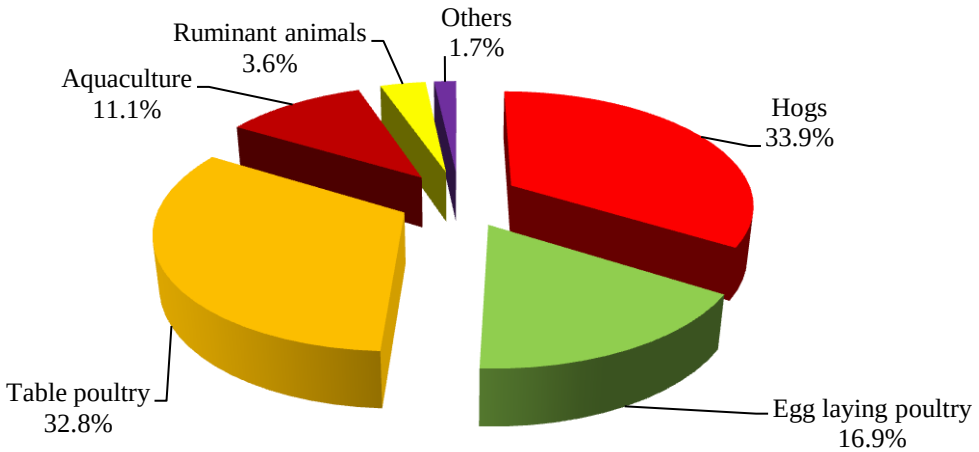
Figure 4.5 Output composition of manufactured feed products in 2001-2011



Source: China Almanacs of Feed Industry 2012.

Compound feed products are used mainly for pig, table poultry and egg-laying poultry, accounting jointly for about 85 percent of total meat output. During the period 2001-2011, the share of pig feed showed a U-shaped change with a trough in 2007 due to mainly occurrence of severe pig diseases in 2006 and a sharp rise of feed prices. While the share of feed for egg-laying poultry declined steadily, the share of feed for table poultry rose with small fluctuations. The amounts of feed products for ruminant animals were still small, but the share rose notably from 2.0 percent in 2001 to 3.6 percent in 2011. China is the largest producer of aquaculture products in the world. Although aquaculture is also intensified, using manufactured feed products is relatively low compared with the livestock sector. The share of aquaculture feed shows an inverse U-shaped movement with a range between 10.1 percent and 14.8 percent.

Figure 4.6 Output structure of compound feed products in 2011

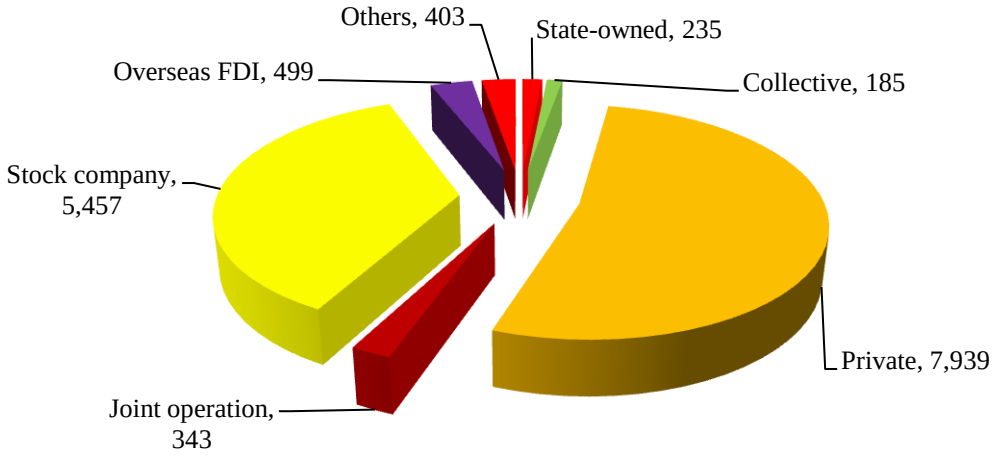


Source: China Almanacs of Feed Industry 2012.

After entering the 21th century, China's feed industry underwent a process of consolidation. Along

with expansion of domestic feed enterprises, foreign agribusiness firms made great efforts to penetrate China's market through joint ventures, mergers, acquisitions, or investment on solely owned facilities. While their production capacity expanded, the number of firms in the industry reduced significantly (CFIA, 2013). As shown in Figure 4.7, most firms in this industry are privately owned or stock companies. This can be taken as an indication that the development of feed industry has been largely driven by market forces. Although there are some large feed enterprises, such as Chia Tai Group (a multinational company based in Thailand), Liuhe Group (a Chinese private company), industrial concentration is still low. It is estimated that the top 10 producers accounted for about 15 percent of the production in recent years (personal communication).

Figure 4.7 Numbers of feed enterprises by forms of property in 2011



Source: China Almanacs of Feed Industry 2012.

Meanwhile, various forms of vertical and horizontal integration between feed enterprises and animal production units is taking place. Some large feed firms have established their own animal raising facilities and extended activities, to feed production, along the supply chain. Meanwhile, and by contrast, medium and small feed enterprises tended to develop contract production with local animal-raising households. As a result of such development, manufactured feed products have now penetrated deeply into the Chinese market.

Chia Tai Group

Chia Tai Group is a well-known multinational company, found by Thai Chinese. The Chia Tai Group is also known as the Charoen Pokphand Group, or the C P Group. Nowadays, the group has branches in over twenty countries and regions around the world, more than 400 subsidiaries with over 200,000 employees.

Chia Tai Group has invested nearly six billion US dollars in China up to now, which turns out an annual sales volume of 50 billion RMB. The establishment of 213 companies is supported by over 80,000 employees and can be found in all provinces, municipalities, and autonomous regions of China expect Qinghai province and Tibet autonomous region. With agriculture and animal husbandry, food industry, commercial retailing as its core business, Chia Tai Group also engages in pharmacy, motorcycles, real estate, international trade, finance, media and other areas of business and operates different industries under common development.

Quoted from CP Group website http://www.cpgroup.cn/en/

5. Summary

China's animal and feed sectors are in a process of rapid evolution. It is expected that the Chinese consumers will continue to increase consumption of animal products in the future. However, China's capacity to increase feed production is constrained by declining agricultural resources, particularly cultivated land and water. As a result, China may increase imports of either feedstuffs or animal products in the years to come. It is expected that such changes will have notable impacts on the global market given the fact that China is now the largest producer of both animal products and cereals in the world. Given the magnitude of the Chinese market and its importance to the global feed and livestock sectors, the reliability and accuracy of China's statistics of animal and feed markets are critical and monitored globally. Consequently improved statistics are crucial for the Chinese government to design sound agricultural policies and strategies.

The available statistics show that China's animal sector and feed sector underwent substantial structural adjustment along with rapid growth during the past two decades. The underlying driving forces include demand changes induced by income growth, technological changes related to R&D and FDI activities, institutional changes resulted from continued socioeconomic reforms, and shifting market conditions related to policy-induced market access. The impact of these factors, along with substantial regional diversity in production practices within China as shown in Table 3.2, makes it extremely challenging for the Chinese government to conduct statistical work on animal and feed sectors which generate sound statistics, in adherence to statistical best practices and with reasonable implementation costs.

With regard to deriving reliable estimates of feed grain consumption in China, a series of factors need to be recognized. Past experiences indicate that China's statistics on animal production are subject to significant over-reporting as revealed by the more recent national agricultural censuses. Moreover, even with notable downward adjustments of animal production, the data still doesn't

correspond to consumption statistics[19]. Large discrepancies suggest that the official statistics collected for different purposes are not internally consistent. It is revealed from the SAPCR that there exist notable variations in feed conversion ratios among different modes of production and among different regions. As China's animal production is still undergoing relocation and intensification, the national means change correspondingly over time. In such a context, using the demand approach to estimate feed consumption is likely subject to large errors due to unrepresentative feed conversion ratios as well as errors in the reported outputs.

In practice, the Chinese government places a high priority on obtaining reliable crop production statistics, particularly for grains. In deriving grain balance sheets, however, whether undertaken by the Chinese Government or foreign institutions, statistics on grain production have to be used as the benchmark to calibrate estimates of other components of the balance sheet, such as feed, food and waste. However, even the data of grain production are frequently questioned for their reliability and logical consistency. The related major issues include under-reported areas of cultivated land, policy-induced misreporting of planted area by some local governments, and, occasionally, by deliberate misinformation of state-managed grain stocks. This implies that the supply approach to deriving feed consumption is also very challenging.

China has no systematic statistics on feedstuffs. The piecemeal information available from various channels are either reported data from incomplete samples or subjective estimates. Given the fact that different people may use different concepts of feed grains, different key parameters, and different benchmarks for their calculations, results are hardly comparable. The lack of transparency in their estimation methods made such estimates unverifiable as well.

Although there exist technical difficulties in designing and implementing statistical schemes on animal and feed sectors, the real barriers for China to produce reliable statistics are institutional factors, such as segmented administrative responsibilities of government bodies, distorted incentives of lower governments to report true situations, weak willingness for micro-entities to disclose private information, etc. It is clear that these barriers can be removed only through reforms in the future, rather than the simple adaption of statistical methods which have proved effective in other countries.

Under the current system, it is no support to the theory that non-state consulting firms are able to provide more reliable statistical information on both animal sector and feed sector. Although the market analyses by such private firms are free from institutional distortions, they commonly suffer from the lack of sufficient human and financial resources to carry out statistical sampling on a scale similar to that undertaken by the NBS and other state bodies. Even if they had needed resources, their activities are also severely restricted by the current government regulations. Such a situation is also applied to the research community as well as foreign institutions. Therefore, instead of trying to find deriving "sound" numbers from non-official sources, attention should be paid to identifying factors affecting quality of the official statistics and to find reasonable approaches to calibrate the data.

[19] China has not published aggregate consumption data. As a result, information of household expenditure surveys is the primary source for checking logical consistency between production and consumption data.

It is clearly a current imperative for the Chinese government to improve its statistics on animal and feed sectors, given the speedy progress in production and processing technologies, the rapid evolvement in organizational forms of production units, and a continued extension of supply chains. For such highly dynamic sectors, the currently used concepts of statistical indicators, data collection methods and ways of implementation are clearly outdated and inadequate. Therefore, the statistical system needs to evolve and adapt to the new situations. This can be achieved only through comprehensive reforms on mechanisms of governance, more institutional collaboration within Government institutions and new and creative ways of working with non-Government entities.

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Appendices

Table A1 Adjustments of the official statistics on livestock production

(Number of animals sold in million)

	Pig			Cattle			Sheep and goats			Poultry		
	I	II	III	I	II	III	I	II	III	I	II	III
1995	481	378		30.5	22.4		165.4	114.2		6302	4884	
1996	527	412		36.5	26.9		194.3	134.1		7189	5571	
1997		465			32.8			159.5			6389	
1998		502			35.9			172.8			6844	
1999		520			37.7			188.2			7432	
2000		527	519		39.6	38.1		204.7			8099	
2001		549	533		41.2	37.9		217.2			8088	
2002		567	541		44.0	39.0		232.8			8329	
2003		592	557		47.0	40.0		259.6			8886	
2004		618	573		50.2	41.0		283.4			9070	
2005		661	604		52.9	41.5		308.0	240.9		9865	9431
2006		681	612		56.0	42.2		329.7	247.3		10176	9305
2007			565			43.6			255.7			9579
2008			610			44.5			261.7			10222
2009			645			46.0			267.3			10609
2010			667			47.2			272.2			11006
2011			662			46.7			266.6			11327

Note: I, II and III refer to original statistics before the first agricultural census, adjusted statistics after the first agricultural census and after the second agricultural census. The statistics of animal stock numbers and outputs of animal products had similar adjustments. Some statistics were not adjusted.

Data source: Compiled by author from statistical publications of NBS (2012) and CAAA (2012).

Table A2 Adjustments of the official statistics on livestock production

(Production of meats in million tons)

	Pork			Beef			Mutton			Poultry meats		
	I	II	III	I	II	III	I	II	III	I	II	III
1995	36.5	28.5		4.15	2.99		2.02	1.52		9.3	7.2	
1996	40.4	31.6		4.95	3.56		2.40	1.81		10.7	8.3	
1997		36.0			4.41			2.13			9.8	
1998		38.8			4.80			2.35			10.6	
1999		40.1			5.05			2.51			11.2	
2000		40.3	39.7		5.33	5.13		2.74	2.64		12.1	11.9
2001		41.8	40.5		5.49	5.09		2.93	2.72		12.1	11.8
2002		43.3	41.2		5.85	5.22		3.17	2.83		12.5	12.0
2003		45.2	42.4		6.30	5.42		3.57	3.09		13.1	12.4
2004		47.0	43.4		6.76	5.60		3.99	3.33		13.5	12.6
2005		50.1	45.6		7.12	5.68		4.35	3.50		14.6	13.4
2006		52.0	46.5		7.50	5.77		4.70	3.64		15.1	13.6
2007			42.9			6.13			3.83			14.5
2008			46.2			6.13			3.80			15.3
2009			48.9			6.36			3.89			15.9
2010			50.7			6.53			3.98			16.6
2011			50.5			6.48			3.93			17.1
2012			53.4			6.62			4.01			18.2

Note: I, II and III refer to original statistics before the first agricultural census, adjusted statistics after the first agricultural census and after the second agricultural census. The statistics of animal stock numbers and outputs of animal products had similar adjustments. Some statistics were not adjusted.

Data source: Compiled by author from statistical publications of NBS (2012) and CAAA (2012).

Table A3 Statistics on scaled livestock production

Pig	Scale category	1-49	50-99	100-499	500-999	1000-2999	3000-4999	5000-9999	10000-4999	>50000	Sum	Reported totals by NBS
	Number sold (m head)	331.5	119.0	160.9	95.4	83.3	43.3	38.6	52.7	9.27	934.0	666.9
Dairy cattle	Scale category	1-4	5-9	10-19	20-49	50-99	100-199	200-499	500-999	>1000		
	Number in stock (m head)	4.34	2.43	2.02	1.58	1.03	0.67	1.16	1.48	1.72	16.43	14.20
Beef cattle	Scale category	1-9	10-49	50-99	100-499	500-999	>1000					
	Number sold (m head)	34.9	11.0	5.4	4.8	2.2	1.5				59.8	47.2
Sheep and goats	Scale category	1-29	30-99	100-499	500-999	>1000						
	Number sold (m head)	177.1	89.7	57.3	12.1	9.9					346.0	272.2
Hen eggs	Scale category	1-499	500-1999	2000-9999	10000-49999	50000-99999	100000-499999	>5000000				
	Output (mt)	5.66	4.834	10.924	6.405	1.199	0.836	0.144			30	27.5

Source: Compiled by author from CAAA (2012).

Table A4 Comparison of China's statistics on pig production and feed utilization of corn

	Pork production (1000 tons)						Pork consumption (1000 tons)			Number of slaughter (1000 heads)		
	NBS	USDA	FAO-1	FAO-2	FAO-3	OECD	USDA	OECD	FAO-3	NBS	USDA	FAO-1
1994	32048	32048	28736	30114	32613	32048	31867	31867	32216	421032	421032	377609
1995	36484	36484	29569	30970	33401	36484	36382	36382	32935	480510	475591	389572
1996	31580	31580	29685	31120	33015	31580	31447	31447	32600	412252	412251	387516
1997	35963	35963	30879	32072	37156	35963	35776	35776	37070	464837	464837	399120
1998	38837	38837	33044	34107	39900	38837	38694	38692	39918	502151	502151	427251
1999	40056	40056	33592	34585	39900	40056	39970	40022	40110	519772	519772	448762
2000	39660	39660	35694	36786	40752	39660	39581	39735	41066	518623	518623	466761
2001	40517	40517	35921	37058	41654	40517	40370	40464	41800	532811	532811	472375
2002	41231	41231	36840	37931	42323	41231	41015	41158	42474	541439	541439	483773
2003	42386	42386	38847	39894	43433	42386	42113	42254	43531	557018	557018	510505
2004	43410	43410	39328	40397	44479	43410	43010	43042	44342	572785	572785	518928
2005	45553	45553	40766	41835	46622	45553	45099	45150	46431	603674	603674	540233
2006	46505	46505	42525	43610	47591	46505	46014	46051	47404	612073	612073	559683
2007	42878	42878	42878	43933	43933	42878	42710	42726	44054	565083	565083	565083
2008	46205	46205	44819	45804	47190	NA	46691	NA	47963	610166	610166	591861
2009	48890	48905	46934	47925	49874	NA	48823	NA	50307	645271	645293	614400
2010	50712	51070	48600	49581	NA	NA	51157	NA	NA	666864	666888	666864
2011	50531	49500	50530	51519	NA	NA	50004	NA	NA	661703	661849	661703
2012	53350	52350	NA	NA	NA	NA	52725	NA	NA	696280	693982	NA

Note: NBS stands for statistics from China's National Statistical Bureau; USDA stands for data from USDA's PSD dataset; FAO-1, FAO-2 and FAO-3 stand for data from FAOSTAT production dataset for mainland China, data from FAOSTAT production dataset for whole China, and data from FAOSTAT commodity balance sheet dataset for whole China; OECD stands for data embodied in OECD's Aglink model (2009 version).

Table A5 Comparison of China's statistics on feed utilization of corn

	Corn production						Feed usage of corn		
	NBS	USDA	FAO-1	FAO-2	FAO-3	AMIS	USDA	FAO-3	AMIS
1990	96819	96820	96819	97214	97214	NA	53350	57974	NA
1991	98773	98770	98773	99148	99148	NA	56500	63606	NA
1992	95383	95380	95383	95773	95773	NA	61000	67605	NA
1993	102704	102700	102704	103110	103110	NA	66000	74503	NA
1994	99275	99280	99277	99674	99674	NA	71000	82565	NA
1995	111990	112000	111986	112362	112362	NA	75000	87637	NA
1996	127471	127470	127470	127865	127865	NA	79000	88401	NA
1997	104309	104309	104310	104648	104648	NA	82500	88204	NA
1998	132954	132954	132954	133198	133198	NA	86500	87812	NA
1999	128086	128086	128086	128287	128287	NA	89500	92814	NA
2000	106000	106000	106000	106178	106178	106000	92000	93931	89000
2001	114088	114088	114088	114254	114254	114090	94000	92212	87000
2002	121308	121300	121308	121497	121497	121310	96000	94079	89000
2003	115830	115830	115830	115998	115998	115830	97000	95072	90000
2004	130287	130290	130290	130434	130434	130290	98000	96853	92000
2005	139365	139365	139365	139498	139498	139370	101000	99470	94500
2006	151603	151600	151603	151731	151731	151600	104000	97572	97500
2007	152300	152300	152300	152419	152419	152300	106000	99932	102000
2008	165914	165914	165914	166032	166035	165910	108000	104113	105000
2009	163974	163974	163974	164108	164108	163970	118000	104512	108000
2010	177245	177245	177425	177541	NA	177240	128000	NA	114000
2011	192781	192780	192781	192904	NA	192780	131000	NA	120000
2012	208120	205600	208130	208258	NA	205610	144000	NA	130000

Note: NBS stands for statistics from China's National Statistical Bureau; USDA stands for data from USDA's PSD dataset; FAO-1, FAO-2 and FAO-3 stand for data from FAOSTAT production dataset for mainland China, data from FAOSTAT production dataset for whole China, and data from FAOSTAT commodity balance sheet dataset for whole China; OECD stands for data embodied in OECD's Aglink model (2009 version).

Table A6 Population and per capita consumption of grains and animal products

	Population (million)		Per capita consumption (kg)							
			Food grains		Pork		Beef & mutton		Poultry meat	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
1985	250.9	807.6	134.76	257.45	17.16	10.32	3.00	0.65	3.84	1.03
1990	302.0	841.4	130.72	262.08	18.46	10.54	3.28	0.80	3.42	1.25
1995	351.7	859.5	97.00	256.07	17.24	10.58	2.44	0.71	3.97	1.83
2000	459.1	808.4	82.31	250.23	16.73	13.28	3.33	1.13	5.44	2.81
2005	562.1	745.4	76.98	208.85	20.15	15.62	3.71	1.47	8.97	3.67
2010	669.8	671.1	81.53	181.44	20.73	14.40	3.78	1.43	10.21	4.17
2011	690.8	656.6	80.71	170.74	20.63	14.42	3.95	1.90	10.59	4.54
2012	711.8	642.2	78.76	164.27	21.23	14.40	3.73	1.96	10.75	4.49

Source: NBS (2013).

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