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**Presenter Information**

J. P. Wu, Z. M. Lei, L. P. Zhang, X. R. Wang, S. G. Zhao, C. Q. Zhang, G. H. Sun, and S. G. Li

# The evolving beef industry and its sustainability in Western China

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**Abstract.** The beef industry in China has started to develop since the 1980s. Since then, its production system has been evolving significantly from subsistence production towards business operation in farmer households. As demands continue to grow, China will become the largest beef consumption country in the world by the year of 2025. The beef production in China's western agriculture regions is gaining significant role in the beef industry of China. Utilization of corn stover and other agriculture aftermath is seen as the competitive advantage of development of the beef industry. Over the last 30 years the beef production efficiency has been improved remarkably. But, the beef industry faces many challenges along with the evolving beef production system. As a result, both beef population and production are declining steadily in the last 5 years. In order to establish a sustained beef industry in western China, there is need to discuss and study the challenges and issues, as well as prepare the technologies and regulations for the evolving beef industry to ensure its sustainability. Efficiency of production system, technologies available for animal health, straw and agriculture aftermath utilization, are the key aspects for the sustained beef industry in western China. Establishment of the effective breeding program suited to production system in Western China is a cornerstone of a sustained beef industry. Effective animal health and vaccination programs need to be established and implemented to ensure the food safety and quality. Finally, optimizations of beef production systems need to ensure the competitiveness of the beef industry and its sustainability.

**Keywords:** Beef industry, production system, market specification, sustainability.

## Introduction

Ruminant production is becoming an important sector of livestock production in China's western agricultural regions where cropping, especially corn production, is growing fast with an abundant feed resource for ruminant production. Ruminant production in the China's agricultural regions consists of sheep, goats and beef production primarily. The beef industry has grown as the significant part of ruminant production in the regions since 1990s. Beef production has developed towards business orientated production as opposed to subsistence activities previously. In the last 15 years the beef industry has been evolving remarkably, especially in the western regions, although it still depends on numerous farmer household operations, which accounts for over 95% of calf and fattening production of the industry (Ding 2012).

China's beef industry started to develop in early 1980. Beef production and consumption has increased proportionally faster than other meats over the last 30 years (Brown *et al* 2002). However, the beef industry did not exist in agriculture regions because cattle were historically draught animals for cropping. Since then, the beef cattle population has increased from about 71 million head in 1980 to 127 million head in 2000 at its highest level (National Statistical Bureau). Beef demand has also increased about 11% from 1985 to 2010 (Si 2012). China is expected to be the largest consumer of beef in the world by 2025 (Yue 2012). As a result, the beef industry and its production system have grown and evolved significantly.

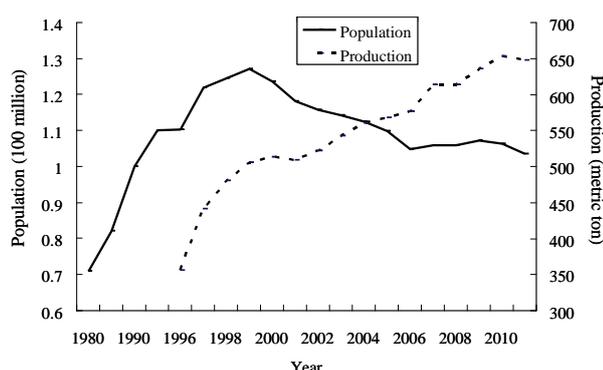
The components of the beef industry have been specialized and farmer household operation scale has extended. At the same time, market infrastructure, such as new live market exchanges and abattoirs, has emerged to meet processing demands.

However, there has also been a decline in the beef cattle herd from the peak of 127 million 2000 to ~100 million in 2012 (Fig. 1). At the same times, beef output reached a production peak of 6.5 million metric ton in 2009, although this too started to decline in 2011 as a result of the reduction in beef cattle numbers. Nevertheless, the efficiency of beef production has been improved remarkably over the last decade (Fig. 1). However, due to the decline of both beef population and production, questions are being raised concerning the sustainability of beef production systems in China.

The objective of this paper is to describe the beef industry and its production system in western China and to discuss the challenges which must be addressed by the beef industry to ensure the future sustainability of beef cattle development.

## Description of beef production system in western China and its evolving manner

Beef production in China's western agricultural regions is typically defined as a typical mixed production system in which cow-calf production is undertaken by the small households with 5 to 10 cows combined with a few paddocks of cropping land (Table 1). Feedlots in western



**Figure 1. Changes of population and production of beef in China.**

China are usually operated by households with average fattening capacity of 50 cattle whereas commercial feedlots are operating large scale enterprises with >1000 head (Haggard and Daley 2013). Live animal markets, local slaughterhouses, larger abattoirs and other necessary infrastructure for the beef industry have developed rapidly in the last ten years (Zan 2009). In addition, the genetic business, feeds additive and feed mills, animal health and veterinary businesses have all expanded to keep pace with farmer and industry demands.

Corn stover which is the main source of roughage for cow-calf production households is mostly sourced from

local crop land. In contrast, the large scale operation households and feedlot companies mostly use hay produced mostly on land leased from neighbors who may be migrant workers in the urban regions.

Cow-calf production generates over 30% of the income for farmer households. However, management is still considerably low which is reflected in reproduction rates of less than 75% and weaning liveweight of ~185 kg at 6-8 months of age. By adopting simple improvement such as providing better nutrition, these production parameters can be easily increased by 25 to 50% (Table 2).

Some cow-calf producers are now retaining the calf until it reaches a liveweight >350 kg (which is considered as stockers or backgrounders in a well developed beef industry) to achieve higher returns. This reflects the general growth in the feedlot business in the past 10 years driven by significant increases in the price of beef. The larger feedlots and large fattening households are located in the corn production region to advantages of an abundant source of grain and straw stover with minimal transport cost. Nevertheless, households are still the main beef production unit both for cow-calf and fattening production in western China. Household operations, for example, still produce nearly 99% of cattle for the slaughterhouse although commercial feedlots are catching up in recent year as shown in Figure 2.

**Table 1. Typical household for cow-calf production.**

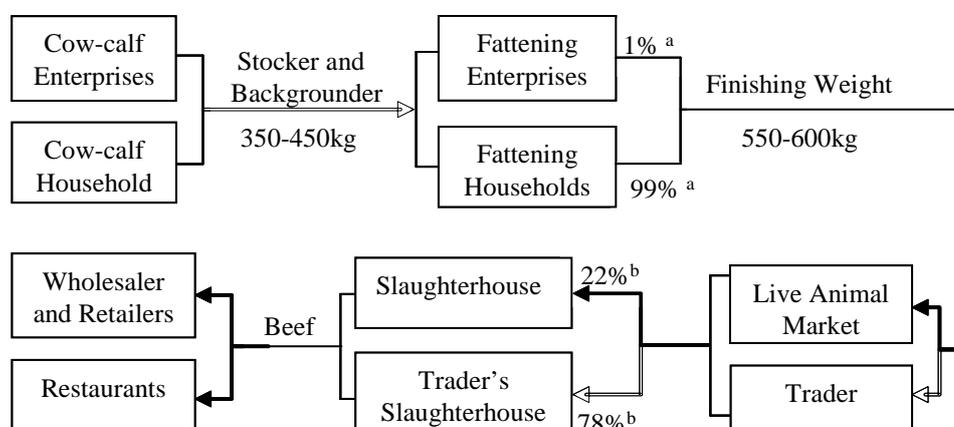
Household	Size (head)	Arable land (mu)	Income (RMB)	Income from beef production	Household Members
Cropping Area	3-5	3-5	22,500	30%	5
Agriculture and Grazing Area	10-20	30-50	42,000	45%	6

(Source: Zhang P 2012); Note: 1 mu = 0.067 ha

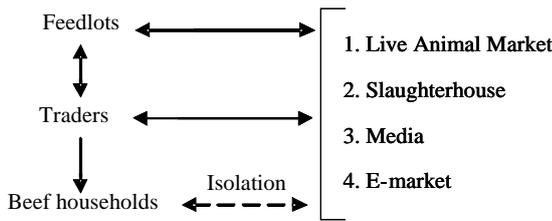
**Table 2. Cow-calf production under two different management systems.**

Management	Feeding scheme	Breeding	Reproduction rate	Weaning weight (kg)
Improved	Balanced ration	Planned	90% Plus	225-250
Tradition	Straw & grain	Non	65-75%	150-185

(Source: Wang 2012)



**Figure 2. Beef cattle industry structure in Western China.** (Sources: National Beef Cattle Industrial Technology System 2012; Zan et al. 2011).



**Figure 3. Beef trading information network.** (Source: [www.cav.net.cn](http://www.cav.net.cn)).

Beef cattle trading is evolving in two forms. The traditional livestock trading pattern in which middle men or livestock traders go from door to door to purchase live animals is still a popular means to secure beef cattle for the feedlot industry or slaughterhouses. However, there is a growing interest in the establishment of live-animal markets with an auction system to replace the traditional approach of one-on-one negotiation. One major drawback to trading is the current market information network which is not well developed (Fig. 3). Market signals do not flow efficiently to household producers which place them at a disadvantaged in the trading process, and seriously delays production responses to market signal. The capacity to transport livestock long distances due to improvement in road infrastructure is seen as an emerging market opportunity across China’s western provinces.

The slaughterhouse business is also operated by two entities. Small slaughterhouses are operated by traders in their back yards, and despite regulation which prohibits this nearly 78% of China’s beef still slaughtered and processed under these conditions. However, the development of supermarket networks across China is bringing about change with processing in modern abattoirs (Fig. 2). Beef from small slaughterhouse is sold directly to local wet food markets or local restaurants. This contrast with the modern abattoirs that produce branded products and processed beef for premium restaurants and supermarkets in China. In western China, newly built modern abattoirs which are costly to build and operate are less competitive than the small slaughterhouses, and it is unlikely that this situation will change until the imposition of regulation and food safety standards which will raise the operation costs of small slaughterhouse (Table 3).

**Table 3. Modern slaughterhouses in major beef production regions and their operation.**

Regions	Beef Counties	Slaughter-houses	Designed Capacity (thousand)	Actual operation in 2010 (thousand)	Operation rate (%)
Northeast	55	59	2904.5	962.7	33.10
Centre	56	107	3505.0	1460.0	41.67
Northwest	29	31	1219.0	342.5	38.10
Southwest	67	9	452.0	84.8	18.80

(Sources: Investigation report for slaughterhouses of beef cattle - Luo and Cao 2011).

**Table 4. Production efficiency of beef fattening in two production system.**

Management	Straw Treatment	Digestibility (%)	ME provided for fattening (%)
Improved	Ensiled	60+	70
Tradition	Dried	45-	45

(Sources : Liang Y 2012a; 2012b; Zhang B 2012).

### Challenges in the beef production development in western China

Although the beef industry has developed rapidly through the evolution of new production systems, challenges and risks are emerging which must be addressed to ensure its further health and sustainability. The following are the outstanding issues and challenges existing in the beef industry of western China.

#### Straw utilization and production efficiency

Straw utilization and treatment is crucial for beef production efficiency as this product of cropping is the main source of feed for beef cattle in western China. Traditionally, naturally dried corn stover was used to sustain beef cattle. However, the low quality which declines further when stored in outside stacks barely meet the maintenance requirement for cattle. A study comparing this traditional stover with ensiled corn stover (as an improved system) showed that dried stover provided only 45% or less metabolic energy required for fattening cattle whereas ensiled corn stover provided 70% (Table 4). The cattle performance was also significantly different between the two management systems. Maximizing the nutritional value of corn stover and wheat straw is especially significant for China, as security of grains remains a top priority. Hay is not available for most beef production systems because of limited arable land.

#### Breeding system and objectives

Artificial insemination (AI) is a widely used technology in western China. Once a service provided by the technicians of local animal husbandry and veterinary stations, private practitioners are now emerging players in providing services, especially to dairy farms. The genetics provided to households is almost free of charge as the AI straw is often procured by government, but the quality is questionable because of poor progeny testing programs of domestic breeding stations. A few households also use natural mating.

Panmictic breeding using whatever genetics available is still a widespread practice in beef breeding in China. Simmental is the most popular breed used in crossbreeding in the west regions for about 30 years even though other

breeds were introduced at the same time as part of national cattle improvement programs in the early 1980s (Table 5). Like other countries, China's beef improvement has centered on large frame cattle rather than on production efficiency and fitness which are often ignored and less pursued.

Indigenous beef breeds developed originally as draught animals with special tolerance to low quality roughage and disease tolerance (Wu *et al* 2013). Preservation of these genotypes should be afforded high priority as they provide a better fit to the emerging production systems and may under-pin the efficiency and sustainability of beef production in western China.

#### *Development of the components of the beef industry*

Household production still plays an important role in the beef industry. Nearly all the cow-calf production and fattening is done in farmer households (Cao 2010), whereas specialized feedlots only takes a small proportion of fattening, although it is catching up. There is a high potential to improve management and efficiency of cow-calf production. In China's beef industry, especially in the west regions, stocker and backgrounder production business is mixed with cow-calf production as farmers often keep calves until they gains significant market value.

#### *Availability of technology and its application*

Availability of technologies and its application are based on the extension system in China, which consists of four parts (Table 6). Extension stations at all levels of government administration provides technical support and extension service to farmers. However, in the last 10 years, research

institutes and universities have emerged as a significant force in the delivery of new technology and supporting extension services, primarily through research projects. Commercial companies also provide technical support through the marketing of new products that improve production efficiency while private consultants such as AI practitioners and veterinarians are involved in promoting adoption of new technology. There are some concerns, however, about the impact of some of these commercial practitioners who still promote out-dated technologies with inefficient extension methodologies which has reduced the effectiveness of extension services. This means there is still much to be done in both the adoption of existing technologies and the development of new technologies required to support and to sustain the fast growing and evolving beef cattle industry.

#### *Food safety and Production management system of beef industry in western China*

Food safety concerns have escalated in China, especially in relation to meats, including beef (Brown *et al* 2002). Animal health still remains an major issue in western China affecting both food safety and quality. The coverage and enforcement of vaccinations against major epidemics across the country, especially in the remote western regions, needs to be strengthened substantially to ensure the food safety and health of the industry. The epidemic prevention program is implemented and enforced by animal husbandry and veterinary bureau through five administrative governments in China (Table 7). The vaccine development is done at central and provincial levels, whereas lower

**Table 5. Introduced beef breeds and its popularity in breeding system in western China.**

Introduced Breeds	Popularity	Year introduced
Simmental	+++++a	1970th
Charolais	++++	1980th
Angus ( Red and Black)	++++	1980th
Limousine	+++	1980th
Piedmontese	+	1980th
Hereford	+	1960th
Japanese black	+	1980th
Other	+b	

Notes: a is most popular genetics used in beef breeding, while b is least popular. (Sources: Li 2009; Yang 2010).

**Table 6. Providers of technical support to beef industry in Western China.**

Providers	
Government forces	The technique extension stations established at all levels of government administration.
Academic institutes	Research institutes and universities deliver technique support through the research projects
Commercial companies	Technique services delivered through marketing of livestock related products
Private sector	Through AI and veterinary practices

**Table 7. Epidemics control and vaccination system of livestock in China.**

Administration body	Functions
Central	Epidemic Monitoring,
Province	Alarming, Vaccine Development and Provision
Prefecture	Vaccination
County	Quarantine,
Township	Supervision
Objectives	Establishment of beef safety and quality retrospective system

(Sources: Ni 2011; China Animal Vaccine Industry Report 2011-2012).

administrations are responsible for implementation and enforcement. However, the coverage and effectiveness of vaccination programs remained questionable because of the numerous households involved in the remote rural regions. Vaccination development targeting different strains of viruses across regions and cold chain in delivering are the two weak points that reduces the effectiveness of the program.

Beef is often wet-cooked with many spices or cooked in the hotpot style with sliced thin beef pieces. Therefore, highly marbled beef is not suitable for the main market of China. Marbled beef reduces efficiency of production and energy utilization. However, premium restaurants are starting to serve western style beef steak and barbecued beef. This diversification of product lines highlights the need for specifications of beef products that farmers can use to guide their management programs. The beef production and suitable beef breeding system need to be established according to the targeted market to ensure the efficiency and sustainability of the beef industry.

The management system determines both the efficiency of production and the safety and quality of the beef products. Feed treatment and storage management, water availability, cattle comfort and animal health are especially important factors to efficiently produce quality and safety food. These factors are commonly seen as the major stresses on cattle in beef production operation. Poor management may results in poor quality of beef and even hazardous products (Wang and Gao 2010). Households that adopted improved management with ensiled stover roughage obtained higher profitability with low cost of average daily growth (ADG) and low cost of entire fattening for finishing cattle (Table 8).

Food safety and quality are the sensitive issues and major concerns of public in China. The products from sick animals, which is often associated with biological or chemical contamination, is a major beef safety issue. The blended beef products using cheap meat, or the injection of water into frozen carcasses, are other practices potentially causing serious contamination. To reduce these impacts the Chinese government is consolidating the monitoring system of food safety and regulation enforcement. Animal welfare is also gaining attention from both the public and producers. However, there is long way to go to be fully aware of animal welfare and to implement management that is required by animal welfare in all parts of production process including housing, feeding, transportation and slaughtering.

#### *Waste treatment and environment protection*

Concentration of beef cattle specialized fattening feedlots raises environment concerns regarding waste treatment and pollution. While manure is commonly recycled as fertilizer

for crop production, other forms of waste from intensified beef operation are causing point source pollution of underground water and river systems (Gao 2013). Improving adoption of waste treatment technology and strengthening regulation enforcement are keys for ensuring the healthy growth of the beef industry in an environment friendly manner.

#### *Beef market information networks*

Beef market information networks are key components of an efficient and sustainable beef industry. In the evolving beef production system in western China, the cow-calf household producers still find it difficult to access beef market information which seriously disadvantages them in the trading process more than any of the other entities of the beef industry. In addition, disconnection from vital market information networks significantly reduces incentives of smaller households to change to more efficient and sustainable beef production management systems.

#### **Perspective of future development of beef industry and its production system**

The beef industry in western China will continue to develop and its production system will continue to evolve to reflect the operation style of exporting countries like Australia, although it is certain that the mixed production system will remain in place for some time. As it is discussed in the previous sections, challenges and issues affecting the development of the beef industry in the western region need to be well addressed so that policies may be put in place to ensure an efficient and sustainable production system.

The application and availability of nutrition technologies will support the efficient production system such as balancing rations for protein, energy, and minerals, and making estimates of nutritive value of feedstuffs readily available. As grain becomes more expensive in the future, technologies to maximize the utilization of crop aftermath and cropping residues become essential for sustained beef production in western China.

As for food safety, it is believed that anabolic implants will be banned and the use of feed additives will be cautious and limited. Water is a critical resource, and an intensified beef industry needs to give special attention to avoid point source pollution of ground water. As the urbanization in China's western regions is still progressing fast, rural labour will become a limiting resource. Beef operations will be further extended as a result of evolving new production systems. Since AI is widely used in beef breeding, a well organized progeny test program needs to be established to ensure there are quality straws available for a sustained beef breeding system. In addition, indigenous beef genetic preservation and utilization needs

**Table 8. Production efficiency of two different management systems.**

Management	Initial weight	Finishing weight (kg)	ADG Cost (RMB/kg)	Total Fattening Cost(RMB)	Corn stover	ME Provided by Straw (%)
Improved	150	600	13	5875	Ensiled	43
Tradition	150	600	14	6372	Dried	23

(Sources: Wang 2012; Zhang B 2012).

to be addressed so that production efficiency and the fitness of cattle that characterize quality beef be maintained. Food safety will continue to be the primary issue of consumers. Animal health and effective vaccination program are outstanding challenges for the beef industry in western China, since parasites and disease organisms are constantly adapting to anthelmintics, antibiotics, and vaccines. New vaccines and drugs need to be developed to ensure the food safety and quality for consumers. Profitability becomes paramount as competition increases and beef prices must hit its ceiling eventually. Therefore, the efficiency of the beef production system is crucial to achieving its sustainability. In China's western regions, straw is the main source of feed for beef production, and introducing and developing technologies to maximize its nutritional value is central to the future of the beef industry. Finally, carcass fabrication and products specifications need to be developed and evaluated using criteria for different consumer markets. This would enable the breeding system and feedlot operations to align more consistently with market targets to ensure production efficiency. Finally, the optimization of beef production systems will ensure the evolving industry will gain sustainability in the future.

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