# Comparative study - Organic Residue Utilization in China and Germany

by Research Center for Rural Economy (RCRE) and University of Hohenheim, December 2016, Beijing

## Table of Contents

### Part 1: Status Quo, Problems and Future development of China’s Agricultural Wastes Utilization

I. Current stock of China’s agricultural wastes ................................................................. 2
II. Major ways and development trend of agricultural wastes utilization in China ...... 3
  1. Major ways to utilize the agricultural wastes .......................................................... 3
  2. The status quo of the utilization of the agricultural wastes ...................................... 5
III. Main problems of China’s agricultural wastes utilization ........................................... 7
  1. High cost of recycling ............................................................................................... 7
  2. Backward research and development in key technologies and equipment ............... 8
  3. Underdeveloped collection, storage and transportation system .............................. 8
  4. Lack of a national systematic supporting policy ....................................................... 9
  5. Little participation by farmers .................................................................................. 9

### Part 2: Chinese Policies on the Utilization of Agricultural Organic Residues

I. Policies and measures at the national level ............................................................... 10
  1. Laws and regulations on utilization of organic residues from agriculture .......... 10
    1.1. Laws on utilization of organic residues from agriculture ......................... 10
    1.2. Laws and regulations and department rules on utilization of organic residues from agriculture ............................................................... 12
  2. Proposals and plans for utilization of organic residues from agriculture.... 13
    2.1. Overall proposals and plans ................................................................. 13
    2.2. Proposals and plans for the utilization of crop straws .............................. 15
    2.3. Proposals and Plans for the Utilization of Animal Manure ...................... 17
  3. Preferential Policies for the utilization of agricultural organic residues .... 17
    3.1. Preferential policies for the utilization of crop straws ............................. 18
    3.2. Preferential policies for the utilization of animal manure ....................... 20
    3.3. Preferential policies for the recycling of plastic films and pesticide packaging from agriculture ................................................................. 22
II. Policy implementation and creation of the local governments ................................. 23
  1. Policies and measures for the utilization of crop straws in Anhui province 23
    1.1. Strengthen supervision of the straw burning ........................................... 23
    1.2. Improve mechanisms and strengthen the utilization of crop straws .......... 24
    1.3. Design support policies and combine them when putting into practice ...... 25
  2. Policies and measures for the governance of contamination caused by animal husbandry and the utilization of animal manure in Zhejiang province ... 26
    2.1. Local laws and documents in Zhejiang ................................................... 26
    2.2. Mandatory policy tools ............................................................................ 26
    2.3. Economic stimulus policy tools ............................................................... 27
III. Conclusion ............................................................................................................... 28
Part 3: A comparative study of the utilization of German-Sino agricultural organic residue resource

(1) The stock status quo of German agricultural residue ........................................ 30
(2) The utilization methods of German-Sino agricultural organic residue resource .. 30
(3) The main existing problems of this resource utilization in Germany ............... 41
(4) German Policy System: Common Agricultural Policy (CAP), Cross Compliance (CC) and Rural Development Policy (RDP) of the European Union....................... 42

Part 1: Status Quo, Problems and Future development of China’s Agricultural Wastes Utilization

By Chinese expert group of the Sino-German Agricultural Policy Dialogue Project

The distinct natural attribute of agricultural production results in the appearance of large amounts of wastes in the process of production and processing. When the agriculture was underdeveloped in the past, most of those agricultural wastes could be utilized by farmers as fertilizer and fuel. With development of agricultural productivity in China in recent years, however, the amount of wastes from agriculture like crop straw, animal manure and waste plastic film has been increasing year by year while at the same time the people’s living standard and income is being improved, leading to a decrease of utilization of these wastes which were once used as fertilizer and fuel. Besides, due to the unclear property right of the wastes, it is difficult for the government to impose supervision, making burning and random abandonment of straw a common phenomenon. Since most of agricultural wastes are organic, throwing them away will not only waste the resources but pose a great threat to the economic growth, agricultural environment and people’s living conditions in rural areas.

The agricultural wastes, known as misplaced resources, can bring great benefits to us if appropriately used, but if thrown away, it will do harm to our environment. Therefore, the utilization of the agricultural wastes becomes a necessity to ensure China’s food safety and quality of agri-products and essential for everlasting use of agricultural resources, improvement of agricultural eco-environment and sustainable development of agriculture. The 2015 No. 1 document from the national central government made it clear to strengthen control of the agricultural non-point source pollution, carry out soil testing and formulated fertilization, popularize bio-organic fertilizer, low toxicity and low residue pesticide energetically, promote regional demonstration of recycling of straw and manure, recycling of plastic film in the field, and implement the environmental impact evaluation system on large-scale breeding farms of livestock and poultry. The policies for the utilization of the residues provide clear guiding principles for the comprehensive use of the agricultural residues especially the organic ones. In the study, the current stock, categories, and the status quo of the agricultural organic wastes will be analyzed first. Then the author will sort out the existing policies in this field and put forward some new development concepts on improving the utilization of the organic agricultural wastes.

I. Current stock of China’s agricultural wastes

Agricultural wastes are discarded organic substances in the whole process of agricultural production. The meaning of agricultural wastes has been defined and is still being developed. Currently, the agricultural wastes mainly refers to wastes from agricultural and forestry production, residues from animal farming and fishery industry, residues from processing and rural and urban wastes. Broadly speaking, there are mainly four types: first, agricultural production wastes, such as straw, weeds, chaff, husk, plant litter, residual fertilizers, pesticides and their packaging, plastic film and other wastes; second, agricultural processing wastes, such as
soybean meal, sawdust, lees, corn cobs, sugar cane bagasse, animal fur, etc.; third, livestock excreta, namely the animal manure, corral padding, etc.; fourth, rural domestic wastes, such as human urine, manure, garbage, etc., as is shown below.

![Diagram of different types of agricultural wastes](image)

Figure 1 Different types of agricultural wastes

China is a big agricultural country with large quantities of agricultural wastes of different types. According to statistics in recent years, China generates about more than 5 billion tons of agricultural wastes annually, the largest in the world, among which the amount of livestock manure is 3.8 billion tons, that of straw is 810 million tons, that of vegetables wastes is 180 million tons, that of plastic film and other wastes is 25,000 tons, that of rural garbage and human excrement is 250 million tons, that of wastes from meat processing plants and crop processing plants is 150 million tons, that of forestry wastes is 50 million tons, and that of other organic wastes is 50 million tons. By 2020, output of China's agricultural wastes will be more than 6 billion tons. These "misplaced resources" could be a potential bank of enormous resources. This article focuses on three types of wastes, namely crop straw, animal manure and plastic film, which are high in stocks and pose a greater threat to environment.

II. Major ways and development trend of agricultural wastes utilization in China

China has a long history of utilizing agricultural wastes. In recent years, with the advancement of technologies and research in this field, the agricultural wastes can be used for more and more purposes. Overall speaking, the wastes can be used for fertilizer, energy, feed, substrate material, and raw material and for other purposes.

1. Major ways to utilize the agricultural wastes
   1.1 Agricultural wastes recycled for fertilizer

It is a traditional way to take agricultural wastes as fertilizer. There are direct and indirect utilization of agricultural wastes. Take crop straw and animal manure as an example, direct utilization refers to applying straw or manure to field directly, the advantage of which is easy to operate and labor saving. Studies show that agricultural wastes when applied to the field directly with help of microbial action slowly decompose and release mineral nutrients for plant uptake and utilization. Meanwhile, decomposed organic matter and humus from the wastes can provide food for soil microbes and other organisms, which to some extent improves soil fertility and increases crop yield. For instance, the fiber plants like straw, if returned to the land, can supplement and renew the organic matter of soil and provide nitrogen, phosphorus, potassium, silicon and other elements. Meanwhile, the crop straw contain rich lignin and cellulose, which will increase the amount of humus after being decomposed, thus greatly enhancing porosity, ventilation, permeability and physical and chemical properties of the soil. Indirect utilization refers to returning waste to field by the means of compost, animal digestion, and incineration etc., which are important
means for farmers to improve soil fertility for thousands of years. However, compost takes long time and occupies large space, making total amount of agricultural wastes keep increasing, imposing great pressure on the environment.

With the development of science and technology, traditional fermentation technology and modern industrial equipment are integrated through the use of biologics like decomposition catalyst, speed decomposition, enzymes bacteria, etc., rapidly mechanizing, scaling up and industrializing the utilization of agricultural wastes for fertilizer. There are many advantages in industrialized utilization of agricultural wastes for producing organic fertilizer, featuring high yield, short production cycle, high fertilizer efficiency, less pollution, easy transportation etc. However, it consumes large amount of energy and the bacteria agents cost high when put into practice, which is a challenge needed to be tackled.

1.2 Agricultural wastes recycled for feed

Agricultural wastes contain a large amount of protein and fiber-like substances which can be used as animal feed when appropriately processed. Both plant fiber wastes and animal wastes can be processed for feed. Plant fiber wastes mainly refer to the substances of crop straw which contains fiber-like substance and a small amount of protein. Straw can be processed by physical, chemical and biological methods consisting of crushing, ammoniating, oxidizing, ensiling, fermentation, enzymolysis etc., to improve its palatability and nutritional value as animal feed. In recent years, the microbial treatment technology is being promoted, mainly used to convert straw, sawdust and other fiber wastes into microbial protein products by fermenting with bacteria, yeast and microalgae. The protein products decomposed by these microbes then can be added to the animal feed to improve the feeding effect. In addition, silage and ammoniation are also the common ways to use as animal feed.

Animal wastes, mainly animal manure and processing byproducts, which contain undigested crude protein, digestible protein, crude fiber, crude fat, minerals etc., can be mixed into animal feed after the treatments of hot-spray, fermentation, drying etc. However, currently much is still needed to be improved in the recycling of animal wastes for feed, so it is not the major trend in the utilization of the agricultural wastes.

1.3 Agricultural wastes recycled for energy

So far, the agricultural wastes recycled for energy in China is realized mainly by biogas fermentation and fuel conversion. The animal manure is used as raw material of biogas fermentation while the crop straw and other plant fiber wastes are used through such ways as making straw briquettes fuel (SDBF), straw power generation, straw gastification, straw pyrolysis gasification and dry distillation.

By recycling the wastes for energy use, we can facilitate the virtuous circle of ecology and alleviate the energy shortage in rural areas. But we still have much to do to achieve it. Due to the backward technologies, many of the agricultural wastes can’t be fully and efficiently utilized in most areas. Taking biogas fermentation as an example, we are faced with climate constraints, unstable production capacity and low safety guarantee and many other challenges. Current research focuses on such popular technologies as chemical, physical or biological methods of converting agricultural wastes into bio ethanol, butanediol, furfural, and furan products. Main ingredients of agricultural waste biomass are cellulose, hemicellulose and lignin, with advantages of large supply, short regeneration cycle, and environmental friendliness. Using modern technology to decompose and convert lignocellulosic feedstock not only ensures effective use of biological resources, but also helps alleviate environmental pollution and energy crisis. In Brazil, the sugar cane residue is used to produce bio ethanol which is then mixed with gasoline upon the proportion of 24% to 76%, being widely used in transport industry. Another potential way is microbial
hydrogen production, a technology of decomposing small molecule organic matter with anaerobic bacteria or nitrogen-fixing bacteria. This technology has the advantages of high hydrogen production, free from time constraint of light, wide range of utilization and simple artifact. Yet so far it has not become universally accessible, the fermentative bio-hydrogen production project in Harbin is the only one and the first one in the world.

1.4 Agricultural wastes recycled for culture substrate

Crop straw, agricultural byproducts, recycled organic waste, breeding waste and other agricultural wastes, after appropriate treatment, can be used as substrate for agricultural cultivation. Such kinds of wastes include corn straw, peanut shells, bagasse, cassava dregs, chicken manure, etc.. For example, the straw can be used as culture material to cultivate edible fungi such as oyster mushroom, beech mushroom, straw mushroom, coprinus comatus and cat fungus. The substrate wastes then can be applied to the field, making full of crop straw and bringing economic benefits to farmers.

The selection, ratio and pretreatment of raw material are essential for the treatment of substrate. The quality substrate should have proper physical and chemical properties, among which most of decomposable organic matter can be decomposed and won’t produce biological nitrogen fixation after being put into soil. Meanwhile, it should meet the standard of removing harmful components like phenols and killing pathogenic bacteria and pest eggs, stably provide water, air and fertilizer the plant roots need and help fix and support the plant growth.

2. The status quo of the utilization of the agricultural wastes

2.1 Crop straws

With China’s grain production increasing for eleven consecutive years, the pressure of crop straw utilization also increased year by year. It is estimated that 819 million tons of crop straws were recyclable, with actual straw use about 622 million tons, comprehensive utilization rate being 76% in 2013. In China, the crop straw is mainly composed of three kinds including maize straw, rice straw and wheat straw which account for 32%, 25% and 18% of the total respectively.

Table 1 the categories of crop straw and their proportion of the total

<table>
<thead>
<tr>
<th>Categories</th>
<th>Rice straw</th>
<th>Wheat straw</th>
<th>Maize straw</th>
<th>Cotton straw</th>
<th>Straw of oil crops</th>
<th>Legume straw</th>
<th>Straw of tuber crops</th>
<th>Other kinds of straw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion (%)</td>
<td>25</td>
<td>18</td>
<td>32</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>11</td>
</tr>
</tbody>
</table>

From a technical point of view, compared with livestock manure and plastic film, comprehensive utilization for crop straw is relatively developed. Currently, technologies of utilizing straw as fertilizer, feed, raw materials, fuel and base material are developing rapidly. The straw is rich in nitrogen, phosphorus, potassium, calcium, magnesium and organic matter. It is a kind of coarse fodder and also a renewable biological resource with multiple purposes. China has a long history of utilizing straw. In the past, it was usually used as the fuel for heating and cooking in the underdeveloped rural areas. Besides, it was also collected to feed animals and compost fertilizer. Now with the rapid development of urbanization and rural economy, the coal, liquefied gas and electricity have been popularized in rural areas, making straw much less popular for fuel use.
So far, the utilization rate of straw for fertilizer, feed, fuel, base material and raw material was 34.8%, 24.7%, 11.3%, 3.6%, and 3.6% respectively. However, there are still 24% of crop straws unutilized which occupy large amount of land and may cause fire, becoming an important source of pollution to the ecological environment and impeding the construction of a beautiful countryside. Especially during the harvest season, some places burn the straw, producing lots of smoke which contains large quantities of pollutants like PM2.5, PM10 and other particulate matter, resulting in bad air quality and arousing public concern. According to a survey of 1,000 large grain producers in 11 provinces of the country, nearly 80% households said they had burned straw in the past five years. Many provinces have increased investment in the comprehensive utilization of straw as a key measure to develop circular and ecological agriculture, construct a beautiful countryside and control air pollution, achieving good results. According to statistics, during 2011-2014, provinces across the nation have spent a total of 6.5 billion yuan on straw utilization, among which Jiangsu, Anhui and Hebei have spent 1.8 billion yuan, 1.56 billion yuan, and 466 million yuan respectively. By the end of 2014, the national straw utilization rate increased from 70.6% in 2010 to 78%. With the increasing investment and enhanced technologies, the technologies of utilizing straw as fertilizer, feed, raw materials, fuel and base material are developing rapidly. Many straw utilization technologies become more mature through industrial demonstration, which are an important support to promote the comprehensive utilization of straw.

### 2.2 Animal manure

Animal manure mainly comes from cattle, pigs, sheep and poultry. In recent years, the total amount of livestock and poultry has kept increasing, with the animal industry becoming ever intensive and large scale. However, animal waste treatment facilities have lagged behind, a lot of livestock manure are unable to be timely processed and utilized, discharging more and more pollutants, making the once traditional organic fertilizer now pollutants, and thus contributing to an increase of pollutant emission.

According to industrial statistics, China produces 3.8 billion tons of livestock and poultry manure annually, the comprehensive utilization rate of which is less than 60%. Our scale livestock and poultry farming produce more than 800 million tons of manure annually, among which only 15% is equipped with biogas projects or other treatment facilities. In 2014, chemical oxygen demand (COD) and ammonia emissions of scale animal farming were 10.49 million tons and 580 thousand tons, accounting for 45% and 25% of the country's total emissions, 95% and 76% of agricultural emissions. There are a total of 24 provinces nationwide where COD emission of livestock and poultry farms accounts for more than 90% of the province's total agricultural emission. Pollutants from the animal husbandry industry have become one of the most important sources of agricultural non-point pollution in China.

Recycling of animal manure is the core and basic principle for pollution control. Currently, most farmers apply livestock manure to the field directly. One farmers’ survey showed that 73.41% of the manure from livestock farming was applied to the field directly, which was the main treatment way, 15.86% piled up on the ground randomly, 6.22% for organic fertilizer production, 0.31% as feed for aquaculture farming, 1.09% for biogas production, 3.11% for other purposes, mainly carried away by other farmers for sales or application to field.

### 2.3 Plastic film

With the rapid growth in mulching using, a lot of waste plastic films are also generated. In 2013, the total amount of plastic film used was 2.493 million tons. Due to the extensive use of ultra-thin film and the lack of plastic film recycling technology
as well as recycling mechanism, the issue of farmland film residues, known as the white pollution, has become increasingly prominent. Less than two thirds of plastic film in season is recycled at present. Plastic film residues in some areas have caused severe pollution. At present, there are two major ways of comprehensive utilization of waste plastic film: first, waste film mulch is crushed, cleaned and made into recycled plastic granules through hot melt extrusion production, which are further processed into PE pipes, plastic containers (such as septic tanks), drip irrigation belt etc.; second, waste film mulch is crushed and mixed with a certain proportion of mineral waste to produce renewable products like well loop, well lid, tree guard etc. Generally speaking, given technical and actual constraints, it is difficult to recycle waste plastic film, and its utilization rate is relatively low.

III. Main problems of China's agricultural wastes utilization

At present, recycling agricultural waste in China is still at the starting stage, with a low level of utilization. There are many constraints and problems in agricultural wastes utilization, which are:

1. High cost of recycling

   Farmers and enterprises are reluctant to recycle agricultural wastes, due to high costs of waste collection and storage, and high product prices. **High cost of collection, storage and transport.** Agricultural wastes are dispersed and in small quantities. Wastes production and processing are usually located in two places, resulting in high labor costs of collection and transportation, as well as high capital costs. Take the mushroom industry for example, substrate for mushroom cultivation mainly comes from corn cob and cottonseed skin. However, cottonseed skin supply cannot meet the need of the businesses that have to pay high shipping costs to procure from other places in some places. In the case of manure utilization, many livestock farms are far away from residential areas, making it impossible to transport surplus biogas and biogas slurry over long distances to reach the farmers, causing a waste of resources to some extent. According to a survey on the utilization of crop straw of farmers and Jinghui Agri-machinery Cooperative in Dongliao county, Jilin conducted in May, 2016, there are mainly two ways to recycle crop straw for farmers and cooperatives. Their respective cost goes as follows:

   Table 1 the utilization methods of crop straw for farmers and cooperatives and their respective cost and profits

<table>
<thead>
<tr>
<th>Recycling methods</th>
<th>cost</th>
<th>profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers send straw to the factory by themselves</td>
<td>7-8.0 yuan/kg (1100kg/mu). Labor cost: 60yuan, transportation cost: 30 yuan (within a distance of five kilometers) total cost: 90 yuan/mu</td>
<td>Sales revenue: 80 yuan/mu Net profit: -10 yuan/mu</td>
</tr>
<tr>
<td>The recycling factories hire professional collection and storage teams to recycle straw</td>
<td>20 yuan/mu for farmers, transportation cost: 40 yuan/mu, stacking cost in the factory: 60yuan/mu. Total cost: 120 yuan/mu</td>
<td>Net profit: 20 yuan/mu</td>
</tr>
</tbody>
</table>

The table displays that the total cost will be 90 yuan/mu, among which 60 yuan is labor cost and 30 yuan goes for the transportation if the farmers collect and send straw to the factory by themselves. The sales revenue is 80 yuan with net profit -10 yuan which means farmers will suffer economic loss. Definitely, they are reluctant to
do that. However, if the factories hire professional straw collection teams, the total cost will be 120 yuan/mu. The straw will be processed directly and then be sold, so the earning can reach 20 yuan/mu and the farmers can gain benefit of 20 yuan/mu. Both sides are more willing to recycle straw in this way. But at the present, the amount of collected straw is still not large since the collection of professional teams is constrained by the cultivation scale, processing technologies and the pricing of the processed products. Overall, the cost is quite high.

**High cost of resource utilization.** It is especially so in the recycling of animal manure and crop straw for fuel production. For example, a company for recycling animal manure and crop straw in Yushu County, Jinlin province made full use of rich manure and straw resources and finally succeeded in developing a kind of biofuel that can be commercialized. But as a result of the high cost of utilization, the fuel consuming enterprises are unwilling to use it. A survey showed that the cost is 580 to 600 yuan to produce one ton of such kind of biofuel while the coal only costs 380 yuan per ton (transported to the destination) and at the same time has higher ignition point and more heat than the biofuel. Therefore, the enterprises are reluctant to buy this biofuel which costs more and is less efficient for use.

2. **Backward research and development in key technologies and equipment**

Technologies of recycling agricultural wastes for organic fertilizer and biogas are relatively successful and are promoted by the Chinese government. However, these technologies remain to be improved. In terms of current national comprehensive utilization of crop straw, the technical specifications for how much straw to return, when and how to return the straw are unclear in some areas where the actual operation of returning straw to field relies on personal judgment and experience. The straw bio-composting technology is inefficient, with nutrient loss during the decomposition process. There are not enough special equipment of high-powered tractors, straw scatters, deep plowing machineries and others, therefore unable to return straw to field efficiently through deep plowing. There is not enough integrated feed harvesting equipment for crushing straw, adding bacteria, packaging etc. In recent years, there emerged in the country a variety of manure recycling models for different kinds of livestock and different farming scales. However, very few cost-effective recycling models are available for promotion in large scale. The main reason is that the technical models are not mature. The prominent manifestation is the lack of technologies to fully utilize the biogas, biogas dregs, and biogas slurry. These technical flaws often result in secondary pollution.

3. **Underdeveloped collection, storage and transportation system**

The market of collection, storage and transportation is the intermediary between buyers and sellers, playing a key role in the utilization of agricultural wastes. However, for the time being, our agricultural wastes collection and storage system is underdeveloped. Take straw as an example, the service mechanism for straw collection, storage and transportation is imperfect. There are not enough brokers, cooperatives and other service organizations, and these organizations are not well located. Poor infrastructure, limited time for straw collection, backward means to collect wastes from field, long time storage, and large space occupied, further increase the costs of collection, storage and transportation. According to one survey, only 13.07% of the farmers say there are straw businesses near their village. Only 7.68% of the farmers say they once sold straw at the price of 100-400 yuan/ton. 57.25% of the farmers say the distance between the collection spots of the straw businesses and the field of the farmers is more than 10 kilometers. Only 7.68% of the farmers say buyers come to their field to collect straw. 43.89% of the farmers say
they burn straw because there is no place to store it, while another 27.63% say they cannot sell it.

4. Lack of a national systematic supporting policy

There is not a systematic and national supporting policy for agricultural wastes recycling in China. Instead, only individual projects are introduced and not on a yearly basis. These projects mainly support ban on straw burning, returning straw to field, subsidizing agricultural machinery, controlling air pollution etc. Some provinces have introduced a subsidy for agricultural wastes recycling, yet at a low standard. For example, some provinces subsidize returning straw to filed at the rate of 10-20 yuan per mu, equivalent to about only one third of the actual costs, leaving farmers pay the other two-thirds. In addition, current policies mainly focus on comprehensive utilization of straw, supporting the manufacturers by preferential tax and subsidies, including special financial subsidies to compensate companies’ costs of straw consumption for producing electricity. Enterprises using straw for production of electricity and heat products are given income tax deduction. However, there are few supporting policies for straw collection, storage, transportation, end-product application etc., which is not good for forming a complete straw industrial chain. Straw is accessible in large quantities throughout the country, therefore, it is necessary to issue a national systematic supporting policy.

5. Little participation by farmers

There are mainly five reasons for little participation by farmers. First, Many farmers are short sighted, unaware of the significance of recycling agricultural wastes and protecting the environment. What they are concerned about is current economic benefits instead of the recycling of wastes and sustainable environment. Second, it costs high for the scattered small-scale cultivation farmers to utilize the agricultural wastes, which has been analyzed before. High cost of recycling is an important reason why farmers are reluctant to do it. Surveys estimate that returning straw to the field costs about 9%-15% of the net income of single-season crop, while collecting straw from the field costs about 15%-30%. Third, China lacks in an effective and sustainable incentive mechanism to encourage the utilization of agricultural wastes. Fourth, media and publicity work is insufficient. The agricultural producers and business bodies can’t fully recognize the importance of utilizing these wastes. As a result, they feel reluctant to recycle agricultural wastes, wasting a lot of resources while causing serious pollution to the environment. Fifth, Farmers know little about relevant policies on agricultural wastes utilization. One survey shows that few farmers know the policy banning burning straw: 9.18% of the farmers surveyed know nothing about it; 16.77% knows little; 48.3% knows fairly; only 25.75% know well.
Part 2: Chinese Policies on the Utilization of Agricultural Organic Residues
By RCRE

In recent years, with great importance attached to the utilization of organic residues from agriculture by Chinese government, laws and regulations, proposals and plans have been issued by relevant departments to provide policy support and institutional guarantee. Local governments also actively participate in it and work out award policies and punishment measures to improve the utilization of the agriculture organic residue.

I. Policies and measures at the national level

The policies and measures at the national level are promulgated and implemented in the form of laws and regulations, department rules, and notifications and plans. They offer the principles and directions to guide at macro level and support utilization of agricultural organic residues.

1. Laws and regulations on utilization of organic residues from agriculture.

Laws and regulations on the utilization of agricultural organic residues include the laws promulgated by the central government, administrative laws and regulations and department rules.

1.1. Laws on utilization of organic residues from agriculture

In early China, utilization of agricultural organic residues belonged to the issues of prevention and control of solid waste, cleaner production, renewable energy and recycling economy. After the “12th Five-year Plan”, however, it was clarified in Agriculture Law of the People’s Republic of China and Environmental Protection Law of the People’s Republic of China, serving as the principles of guidance and control.

On October 30, 1995, Law of the People’s Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste was adopted during the sixteenth session of the Standing Committee of the 8th National People’s Congress, indicating legalization of China’s utilization of solid waste. Yet there were no provisions on the recycling of the solid waste from agriculture.

According to Law of the People’s Republic of China on Promotion of Cleaner Production approved by the Standing Committee of the 9th National People’s Congress during its 28th session on June 29, 2002, the solid waste, waste water and remaining heat shall be recycled or comprehensively used. “Agriculture producers should use fertilizers, pesticides, plastic films for agriculture and fodder additives in a scientific way and enhance planting and cultivating technologies to produce high quality and healthy agri-products, recycle the agricultural production waste, and prevent environmental pollution.” It was the first time to include the utilization of the agricultural waste into laws, but no specific measures were noted.

It was not until in 2004 the provisions on comprehensive use of agricultural residues were added to the revised Law of the People’s Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste. Under Article 19 and 20 of the law, the State encourages research institutions and manufacturers to conduct research and manufacture thin-film sheeting and product packaging materials that are easy to be recycled or treated, or are degradable in the environment. Units and individuals that use agricultural thin film shall take measures to recycle it or other measures in order to prevent or reduce environmental pollution by such film. An entity engaged in raising livestock and poultry in a large scale shall,
in conformity with relevant State regulations, collect, store, utilize or treat the excrement and urine discharge by the livestock and poultry, in order to prevent environmental pollution. Open-air burning of stalks in densely-populated areas, in the neighboring areas of airports, on the peripheries of the main lines of communications and in the areas delimited by local people’s governments is prohibited.

On February 28, 2005, *Renewable Energy Law of the People’s Republic of China* was adopted and promulgated during the 14th Session of the Standing Committee of the 10th National People’s Congress, providing legal guarantee for the comprehensive use of straws.

*Circular Economy Promotion Law of the People’s Republic of China* approved during the fourth session of the Standing Committee of the 11th National People’s Congress on August 29, 2008 clearly stated that the State encourages and supports agricultural producers and relevant enterprises to employ advanced or applicable technologies to make a comprehensive utilization of straws of crops, excrements of poultry and livestock, by-products from the processing of agricultural products, and waste agricultural films, and develop and use marsh gas and other biomass energies. (See table 1).

*Agriculture Law of the People’s Republic of China* revised and approved by the Standing Committee of the 11th National People’s Congress during its 30th session on December 28, 2012 clearly stated that straws and other residual materials after the reaping of agricultural products shall comprehensively be utilized and properly disposed of in order to prevent environmental pollution and ecological destruction. Units and individuals engaged in raising livestock and poultry in scale shall conduct decontamination or make comprehensive utilization of their excrements and urines, waste water and other waste materials; and units and individuals engaged in aquaculture shall rationally use feedings, fertilizers and medicines in order to prevent environmental pollution and ecological destruction.

In *Environmental Protection Law of the People’s Republic of China*, revised and adopted by the Standing Committee of the 12th National People’s Congress during its 8th session on April 24, 2014, it was clearly stated that The people’s governments at various levels and their agriculture and other relevant departments and agencies shall guide agricultural producers and operators to conduct scientific cultivation and plantation, rationally apply cultivating additions such as pesticides and fertilizers, and properly handle agricultural wastes including agricultural films and crop straw and prevent non-point sources agricultural pollution.

Table 1 Laws on utilization of the agricultural waste

<table>
<thead>
<tr>
<th>Year</th>
<th>Unit</th>
<th>Name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>The NPC Committee</td>
<td>Standing</td>
<td><em>Law of the People’s Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste</em></td>
</tr>
<tr>
<td>2002</td>
<td>The NPC Committee</td>
<td>Standing</td>
<td><em>Law of the People’s Republic of China on Promotion of Cleaner Production</em></td>
</tr>
<tr>
<td>2008</td>
<td>The NPC Committee</td>
<td>Standing</td>
<td><em>Circular Economy Promotion Law of the People’s Republic of China</em></td>
</tr>
<tr>
<td>2012</td>
<td>The NPC Committee</td>
<td>Standing</td>
<td><em>Agriculture Law of the People’s Republic of China</em></td>
</tr>
<tr>
<td>2014</td>
<td>The NPC Committee</td>
<td>Standing</td>
<td><em>Environmental Protection Law of the People’s Republic of China</em></td>
</tr>
</tbody>
</table>

Sorted out by the author
1.2 Laws and regulations and department rules on utilization of organic residues from agriculture

Department rules identify the specific administration measures and provisions on utilization of organic residues from agriculture mainly concerning use of straws, treatment of waste from animal husbandry and packaging of pesticides.

Utilization of straws. In April, 1999, Ministry of Environmental Protection of the People’s Republic of China (MEP), in cooperation with other five ministries and commissions (National Development and Reform Commission, Ministry of Public Security, Ministry of Science and Technology, Ministry of Finance, Ministry of Commerce and National Bureau of Statistics), issued Administration Measures on Prohibiting Straw Burning and the Comprehensive Utilization of straws (Issue No. 98 [1999] by MEP), in which it was stated that straw burning shall be prohibited within the range stipulated and local governments should actively promote mechanized straw returning to the field, development of straw feed, straw gastification, water-logged microbe compost of straws under high temperature, development of straws as industrial raw materials and other technologies.

Utilization of animal waste. In May, 2001, MEP adopted Administration Measures on Prevention and Control of Contamination by Animal Husbandry (Order No. 9 by MEP). The principles of resource recovery, decontamination and reduction shall be with priority given to comprehensive utilization for preventing and controlling contamination caused by animal farming. Farmers of animal keeping shall be required to take measures to comprehensively use animal manure through such ways as returning it to the farmland, fermenting biogas, producing organic fertilizers and feed. The manure returned back to the farmland should measure up to the decontaminated standard to prevent bacteria communication. To further standardize breeding activities and reduce environmental pollution, the State Council issued Ordinance on Prevention and Control of Contamination by Animal Farming in Scale (Order No.643), the first volume of administrative regulations exclusively on environmental protection in agricultural and rural areas. “The State encourages and supports such comprehensive utilization methods of animal manure as returning to the farmland, producing biogas and organic fertilizers. Direct emission of untreated waste to the environment shall be prohibited,” as was stipulated in the Ordinance.

Utilization of pesticide packaging. In April, 2015, MEP issued Administration Measures on Recycling and Treatment of Pesticide Packaging Waste (on trial) which clearly stipulated that the pesticide packaging waste should be recycled. The principles of “manufacturers take responsibilities, sellers recycle and users return” shall be followed to reduce, recycle and decontaminate the waste. Besides, a tracking system for recycling pesticide packaging waste shall be established to encourage classification of the waste, thus realizing reutilization of resources. (See table 2)

### Table 2 Laws and regulations and department rules on utilization of agricultural residues

<table>
<thead>
<tr>
<th>Year</th>
<th>Unit</th>
<th>Name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>MEP of the PR</td>
<td>Administration Measures on Prohibiting Straw Burning and the Comprehensive Utilization of straws</td>
<td>Department rules</td>
</tr>
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<td>2001</td>
<td>MEP of the PRC</td>
<td>Administration Measures on Prevention and Control of Contamination by Animal Husbandry</td>
<td>Department rules</td>
</tr>
<tr>
<td>2013</td>
<td>State Council</td>
<td>Ordinance on Prevention and Control of Contamination by Animal Farming in Scale</td>
<td>Laws and regulations</td>
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</table>
2. Proposals and plans for utilization of organic residues from agriculture

Within the framework of the laws and regulations, most of the policies on utilization of organic residues from agriculture are identified according to the proposals, plans and rules issued by department of the central government. They cover the overall proposals and plans on utilization of agriculture organic residues and also the specific policies and measures for use of straws and animal manure.

2.1 Overall proposals and plans

Since the beginning of 21st century, the State has worked out a series of proposals and plans to define areas and methods, technical standards and project priorities pertaining to the utilization of organic residues from agriculture. With deepening concept of “green development” since the “12th Five-year Plan”, increasingly importance has been attached to utilization of organic residues from this sector.

In August, 1996, the State Council issued State Council’s Approval and Forwarding of National Economic and Trade Commission and Other Departments on the Implementation of Comprehensive Utilization of Resources (Issue No.36 [1996] by State Council) based on the Law of the People’s Republic of China on Prevention and Control of Environmental Pollution by Solid Waste promulgated in 1995, in which the range for resource comprehensive use was clearly defined but no mention of organic residues. In 2003, the comprehensive utilization of resources was identified as a major policy on technical economy in Catalogue of Comprehensive Utilization of Resources (revision 2003). According to the revised version, power generated by using geothermal energy and waste from agriculture and forestry, and construction products made out of such raw materials as wood shavings, sawdust, crop residues, residues from sugar industry, fly ash, smelting slag, effluent (Magnesium chloride/MgCl₂) from salt and chemical plants, etc. belong to comprehensive utilization of resources. In February, 2006, the State Council issued Outline of National Mid and Long-term Development Plans on Science and Technology (Issue No.044 [2005] by State Council), giving priority to the environment-concerned topic of “pollution control and utilization of wastes”. In July, 2010, National Development and Reform Commission (NDRC), with other five ministries and commissions, jointly issued Outline of Technical Policies on Comprehensive Utilization of Resources in China (Notification No.14 in 2010), outlining 23 items of technologies for comprehensive use including waste from agriculture and forestry. And technologies for dealing residues of straws and animal husbandry were elaborated.

During the period of the 12th Five-year Plan, the State carried out quite a lot plans and proposals for utilization of organic residues from agriculture. For example, in the Outline of the 12th Five-year Plan on National Economic and Social Development in March, 2011, comprehensive utilization of straws, waste in livestock and poultry farming and wood wastes was listed as an important part to improve living and production conditions in rural areas and develop a type of recycling economy. In September of the same year, Ministry of Agriculture (MOA) issued the 12th Five-year Plan for National Agricultural and Rural Economic Development, pointing out that we should promote utilization of agricultural residues like crop straws and animal manure according to local geographical features and treating them before emission so as not to cause environmental contamination. The projects of rural biogas, rural clean and energy generation by straws should be put first on the
implementation agenda. Then two months later, Ministry of Finance (MOF), National Energy Administration (NEA), and MOA jointly issued *Interim Measures on the Administration of Subsidies for Construction of Green Energy Demonstration Counties* (Issue No.113 by Department of Economic Construction, MOF), *Measures on the Administration of Construction of Green Energy Demonstration Counties* (Issue No.164 [2011] by the Department of New Energy, NEA), and *Interim Measures on the Administration of Technologies for Construction of Green Energy Demonstration Counties* (Issue No.5 [2011] by Department of Science, Technology and Education, MOA), defining the areas, qualifications, standards of engineering technologies, technology-supported service networks involved in carrying out such projects as centralized supply of biogas, biomass gasification and biomass briquettes in green energy demonstration counties. In December, MOA issued *Ministry of Agriculture on Proposals for Promoting Energy Conservation and Emission Reduction in the Agricultural Sector and in Rural Areas*, giving guidance to the work in this field during the 12th Five-year Plan Period. Great efforts should be made to develop biogas projects in rural areas, thus the animal waste can be reused and a better environment can be achieved and at the same time, to promote comprehensive utilization of straws and recycling of film mulch. Besides, NDRC issued in December the *Implementation Schemes on Comprehensive Utilization of Major Solid Wastes and Guidelines on Comprehensive Utilization of Resources during the 12th Five-year Plan* (Issue No.2919 [2011] by the Department of Resource Conservation and Environmental Protection, NDRC) which stated that waste from agriculture and forestry is an important part of the waste utilization industry. A purchase-store-transport system for straws should be established and the straws used as fertilizers, feed, base material, raw materials and fuel should be promoted by taking utilization of crop straws as a key project in the process of performing comprehensive use of resources. Residues from animal husbandry should also be comprehensively used. In October 2014, General Office of MOA issued *Models on Arable Land Protection and Technologies Enhancement 2014* (Issue No.39 [2014] by General Office of MOA), putting forward technologies of straw returning to the farmland, green manure cultivation and application to organic fertilizers so as to improve comprehensive production capacity of the arable land.

In order to guide the comprehensive utilization of organic residues from agriculture during the next Five-year Plan, the central government issued No.1 Document, *Proposal for Deepening Reform, Strengthening Innovation and Speeding up Agricultural Modernization* (No.1 Document [2015] by the Central Government). In accordance with this document, we should strengthen governance of agricultural ecology, the development of agricultural recycling economy, utilization of straws and animal manure and demonstration regions of the recycling of farmland plastic film waste. In February, 2015, MOA issued *Proposal for Doing a Good Job in Agricultural and Rural Economy 2015*, proposing to strictly put into practice the *National Agricultural Sustainable Development Plan and Overall Plan for the Governance of the Major Issues of Agricultural Environment* through the methods mentioned just now in the No.1 document and other methods like construction of subsidy pilots of pesticide packaging recycling.

In April, 2015, MOA issued *Proposal for the Implementation of Prevention and Control of Agricultural Non-point Source Pollution* (issue No.1 by Department of Science, Technology and Education), aiming to control the consumption of water in agriculture, reduce the use of chemical fertilizers and pesticides and basically realize the utilization of animal waste, crop straws and agricultural plastic films. In May of the same year, MOA, in cooperation with NDRC and six other departments issued *National Agricultural Sustainable Development Plan (2015-2020)*, putting forward that China will realize on the whole the reutilization of agricultural resources in National Modern Agriculture Demonstration Zones and major grain-producing counties by 2020 and zero emission of agricultural residues by 2030 nationwide (see table 3).
Table 3 Notices and plans for agricultural organic residues

<table>
<thead>
<tr>
<th>Year</th>
<th>Unit</th>
<th>Name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>State Council</td>
<td>State Council’s Approval and Forwarding of National Economic and Trade Commission and Other Departments on the Implementation of Comprehensive Utilization of Resources</td>
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<tr>
<td>2005</td>
<td>State Council</td>
<td>National Mid and Long-term Development Plans on Science and Technology</td>
<td>Plan</td>
</tr>
<tr>
<td>2010</td>
<td>NDRC and other five departments and commissions</td>
<td>Outline of Technical Policies on Comprehensive Utilization of Resources in China</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>State Council</td>
<td>Outline of the 12th Five-year Plan on National Economic and Social Development</td>
<td>plan</td>
</tr>
<tr>
<td>2011</td>
<td>MOA</td>
<td>the 12th Five-year Plan for National Agricultural and Rural Economic Development</td>
<td>plan</td>
</tr>
<tr>
<td>2011</td>
<td>MOF, NEA and MOA</td>
<td>Interim Measures on the Administration of Subsidies for Construction of Green Energy Demonstration Counties</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>NEA, MOF and MOA</td>
<td>Measures on the Administration of Construction of Green Energy Demonstration Counties</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>MOA, NEA and MOF</td>
<td>Interim Measures on the Administration of Technologies for Construction of Green Energy Demonstration Counties</td>
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<tr>
<td>2011</td>
<td>NDRC</td>
<td>Guidelines on Comprehensive Utilization of Resources during the 12th Five-year Plan</td>
<td></td>
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<tr>
<td>2014</td>
<td>NDRC</td>
<td>Implementation Schemes on Comprehensive Utilization of Major Solid Wastes</td>
<td></td>
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<td>2014</td>
<td>MOA</td>
<td>Models on Arable Land Protection and Technologies Enhancement 2014</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>The CPC Central Committee and State Council</td>
<td>Proposal for Deepening Reform, Strengthening Innovation and Speeding up Agricultural Modernization</td>
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<tr>
<td>2015</td>
<td>MOA</td>
<td>Proposal for Doing a Good Job in Agricultural and Rural Economy 2015</td>
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<tr>
<td>2015</td>
<td>MOA</td>
<td>Proposal for the Implementation of Prevention and Control of Agricultural Non-point Source Pollution</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>MOA and other seven departments and commissions</td>
<td>National Agricultural Sustainable Development Plan (2015-2020)</td>
<td>plan</td>
</tr>
</tbody>
</table>

Sorted out by the author

2.2 Proposals and plans for the utilization of crop straws

In order to realize the utilization of crop straws, China has carried out a series of plans, proposals and technological catalogues for the collection, storage and transportation and processing of those straws which provide mechanisms, methods and technologies for its utilization. And it was even more so since “the 12th Five-year Plan” was carried out.

In Plan for the Comprehensive Use of Crop Straws issued in 2005, China worked out the key technologies to develop in such areas as biomass generation, biomass briquette fuel (BMF), biogas use, non-grain ethanol fuels and biodiesel and set goals for their total amounts respectively. Besides, the overall development goal for the utilization of crop straws was set, too. In order to control the environmental pollution and waste of resources caused by straw burning, MOA issued an Urgent
Notice on Prohibiting Straw Burning and further Strengthening Comprehensive Utilization of Crop Straws (issue No.20 [2007] by General Office of the State Council) in June, 2007, targeting at speeding up the promotion of comprehensive utilization of crop straws and effectively curbing illegal burning of straws. In July, 2008, the General Office of the State Council issued Proposal for Accelerating the Promotion of Comprehensive Use of Crop Straws (issue No.105 [2008] by the General Office of the State Council), proposing to vigorously promote the comprehensive use of straws in crop farming and animal keeping and orderly develop biomass energy and processing industry with straws as raw materials. It was also proposed that China would strive to basically establish a straw collection system and form a rational layout featuring multiple uses and industrialization by 2015 with the comprehensive utilization rate reaching over 80%. In February, 2009, NDRC and MOA, in the aim of putting into practice the ideas of the No.105 Document, jointly issued Notice on Issuing Instructions of Working out Plans for Comprehensive Utilization of Crop Straws from National Development and Reform Commission and Ministry of Agriculture (issue No.378 [2009] by Department of Resource Conservation and Environmental Protection), proposing that plans would be formulated at the provincial level and key technologies would be provided to promote the implementation of comprehensive use of crop straws in local areas.

In November, 2011, Plans for the Implementation of the Comprehensive Use of Crop Straws during “the 12th Five-year Plan” (issue No. 2615[2011] by Department of Resource Conservation and Environmental Protection) was jointly issued by NDRC, MOA and MOF, serving as the guidance for local governments to promote comprehensive utilization of the crop straws during the “12th Five-year Plan” period. According to the Plan, China shall by and large establish a relevantly complete system for the field treatment, collection, storage and transportation of crop straws and formulate an industrialized pattern of comprehensive utilization characterized by rational layout (distribution) and multiple uses by 2015. Besides, it also set out the specific goals and project implementing priorities for utilization of straws as base materials, raw materials, fuels, and materials for fertilizers and feed production. And in October, 2014, NDRC and MOA issued Catalogue of Technologies for Comprehensive Utilization of Crop Straws 2014 (issue No.2802 [2014] by Department of Resource Conservation and Environmental Protection). It includes the categories, names, connotations, contents, characteristics and implementation do’s and don’ts of those technologies as well as major technical norms and standards that can be followed and suitable for straw treatment, offering guidance for carrying out best and practical technologies, thus pushing forward the industrialized development of the comprehensive utilization of crop straws.

In order to guide the work in this area during “the 12th Five-year Plan”, NDRC, MOA and MEP jointly issued Notice on Accelerating the Promotion of Burning Prohibition and Comprehensive Utilization of Crop Straws (issue No. 2651 [2015] by NDRC and Department of Resource Conservation and Environmental Protection) in October, 2015, putting forward that by 2020, over 85% of the straws shall be used comprehensively nationwide with the area of burning straws decreasing by 5% compared with that of 2016, and open burning shall not be seen any more in densely-populated areas, areas near to the airport and along traffic arteries and other areas designated by local governments. Meanwhile, it was also pointed out that China will drive forward industrialization of comprehensive utilization of crop straws, explore more channels for use of straws, improve working mechanisms, strengthen supervision of straw burning, and enhance technologies and collection and utilization of straws. In May, 2016, MOA, in cooperation with MOF, issued Notice on Launching Pilots of Comprehensive Utilization of Crop Straws and Improving the Quality of Arable Land (issue No.39 [2016] by the General Office of MOA and MOF), pointing out that 10 provinces and autonomous regions (e.g. Hebei, Shanxi) where the issue of straw burning is a common concern will be selected as pilots to promote
comprehensive utilization of straws with focus on quality improvement of arable land. Agricultural use of straws will have a leading role to play. Farmers are encouraged to return those straws to the field after mechanical treatment, biological composting or digestion of animals, thus further improving its use as fertilizers and feed (see table 4).

Table 4 Proposals and Plans for the Utilization of Crop Straws

<table>
<thead>
<tr>
<th>Year</th>
<th>Unit</th>
<th>Name</th>
<th>Note</th>
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</thead>
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<tr>
<td>2007</td>
<td>MOA</td>
<td>Urgent Notice on Prohibiting Straw Burning and further Strengthening Comprehensive Utilization of Crop Straws</td>
<td></td>
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<tr>
<td>2008</td>
<td>the General Office of the State Council</td>
<td>Proposal for Accelerating the Promotion of Comprehensive Use of Crop Straws</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>NDRC and MOA</td>
<td>Notice on Issuing Instructions of Working out Plans for Comprehensive Utilization of Crop Straws from National Development and Reform Commission and Ministry of Agriculture</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>NDRC, MOA And MOF</td>
<td>Plans for the Implementation of the Comprehensive Use of Crop Straws during “the 12th Five-year Plan”</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>NDRC and MOA</td>
<td>Catalogue of Technologies for Comprehensive Utilization of Crop Straws 2014</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>NDRC, MOF, MOA and MEP</td>
<td>Notice on Accelerating the Promotion of Burning Prohibition and Comprehensive Utilization of Crop Straws</td>
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<tr>
<td>2016</td>
<td>MOA and MOF</td>
<td>Notice on Launching Pilots of Comprehensive Utilization of Crop Straws and Improving the Quality of Arable Land</td>
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</tbody>
</table>

Sorted out by the author

2.3 Proposals and Plans for the Utilization of Animal Manure

The utilization of animal manure is an effective way to prevent and control contamination from animal husbandry. China has worked out a series of standards and technical norms for the whole production chain from production plan to operation and waste emission in order to deal with the problem of contamination from animal husbandry. Regrettably, however, policies for utilization of animal manure are rather scant. In March, 2010, MOA issued Proposal for Speeding up the Promotion of Standardized and Scale Animal Farming from Ministry of Agriculture (issue No.6 [2010] by Department of Livestock Production), pointing out that the waste should be decontaminated or reused in standardized animal farming. For those areas with relatively high density of animal farming in scale, animal waste treatment centers or plants can be built to produce organic fertilizers, realizing utilization of the waste. Then in October, 2012, “The 12th Five-year Plan” for National Prevention and Control of Contamination from Animal Husbandry was issued in which MOA mapped out that we should develop the practical technologies for prevention and control of animal keeping contamination with priorities given to the development of the highly-efficient composting technology and the technology for comprehensive utilization of biogas slurry and residue, and establish a group of efficient manure composting technology demonstration projects on the basis of the emission reduction programs of the total amount of major pollutants from animal farming.

3. Preferential Policies for the utilization of agricultural organic residues

Since preferential policies play an important part in the orderly development of the utilization of organic residues from agriculture, China has carried out tax incentives, granted subsidies, offered credit and price support and other measures to encourage the production and consumption of the main bodies engaged in the utilization of those residues.
3.1 Preferential policies for the utilization of crop straws

China has quite complete preferential policies for the utilization of crop straws. In July, 2008, the General Office of the State Council issued *Proposal for Accelerating the Promotion of the Comprehensive Utilization of Crop Straws* (issue No.105 [2008] by the General Office of the State Council), clarifying the measures to support the utilization of crop straws, which go as follows: (1) increase capital input. Grant subsidies to the research and development of the key technologies and equipment for power generation, gastification and ethanol production of straws and its collection, storage and transport; (2) make the farm machinery subsidies cover the machines used for straw silage or returning to the field; (3) offer certain financial support for the application of the straw returning to the field or gastification and production of straw densified briquettes fuel (SDBF); (4) offer credit support for the purchase of straw treatment machines by companies engaged in comprehensive utilization of crop straws and agricultural machinery service organizations; (5) offer tax incentives and price concessions by making comprehensive utilization of straws a part of the encouragement and support for the structural adjustment of national industry and comprehensive utilization of resources, formulating and improving relevant tax incentives according to the links involved and its purposes, and enhancing price concession policies concerning straw power generation and other renewable energies. Here is the detailed explanation of the measures.

Assistance fund and awards. In October, 2008, MOF issued *Interim Measures on the Administration of the Subsidies for the Utilization of Crop Straws* (issue No.735 by Department of Economic Construction) in which it was clearly stated that the central government set up special funds, giving overall subsidies in line with set standards to the enterprises engaged in qualified SDBF production and straw gastification in accordance with the types and amount of straws they consumed that was converted from the actual annual sales of the straw-made products. Besides, according to *Notice on Launching Pilots of Comprehensive Utilization of Crop Straws and Improving the Quality of Arable Land* which was mentioned before, for those pilot areas, the mechanism of “substituting awards for subsidies” shall be adopted. The central government grants appropriate subsidies based on the status of the comprehensive utilization of straws in the pilots, but the distribution of those subsidies will be determined by the pilot provinces themselves according to their tasks, targeting at supporting the key areas and links of the comprehensive utilization of straws.

Tax incentives. In December, 2008, MOF issued *Notice of State Administration of Taxation of Ministry of Finance on Value-added Tax Policies for Comprehensive Utilization and other Products* (issue No.156 [2008] by State Administration of Taxation of MOF), stipulating that the sale of power generated with straws as fuel can enjoy immediate return of VAT levied. And at the same time, the enterprises engaged in generating power or heating or processing wood products with crop straws and husk as major materials will be listed under *Catalogue of Corporate Income Tax Preference for the Comprehensive Utilization of Resources*. The taxable income can be calculated on the basis of 90% of the total income and 10% deducted. In June, 2015, MOF issued a notice on *Catalogue of Value-added Tax Preferences for the Products and Services of the Comprehensive Utilization of Resources* (issue No.78 [2015] by State Administration of Taxation of MOF). As stipulated in the notice, tax payers who sell self-produced products pertaining to comprehensive utilization of resources and provide labor services of this area (hereinafter referred as sale of products and services of comprehensive utilization) can enjoy the policy of “immediate return of VAT levied”. But the following technical standards must be met when they use waste paper and crop straws to manufacture paper pulp, straw pulp and paper: (1) over 70% of the raw materials must be the resources listed in the Catalogue; (2) the emission of waste water meets the technical requirements
stipulated in the Standards for the Emission of the Water Pollutants from Pulp and Paper Industry (GB3544-2008); (3) the tax payers meet the technical requirements in the Evaluation Index System of Cleaner Production in Pulp and Paper Industry. The tax rebate percentage is 50%.

Subsidies. In November, 2015, NDRC, MOF, MOA and MEP jointly issued Notice on Accelerating the Promotion of Burning Prohibition and Comprehensive Utilization of Crop Straws (issue No. 2651 [2015] by NDRC and Department of Resource Conservation and Environmental Protection), proposing to improve support policies and establish effective incentive mechanisms. As for the financial input, the local governments should, in accordance with their actual situation, coordinate funds to offer more support to straw organic fertilizer, straw returning to the field, animal farming with straws and other projects of comprehensive utilization of straws. For those areas with high frequency of straw burning, more financial fund should be put in to help tackle this problem and promote comprehensive utilization of them. In addition to subsidies, the Notice also mentioned the following aspects as financial credit, land use and price concessions:

Financial credit. The banking and financial institutions are encouraged to innovate financial products and services by taking into consideration the features of the comprehensive utilization of straws and actively provide financial credit support for the enterprises engaged in storage and processing of straws.

Land use. The land policies favorable for utilization of straws shall be implemented. The inventory land for construction, idle and waste land shall be the first choice for the warehouse of straws, and in principle, their management shall follow the rules of interim land use. If it is permanent appropriation, review and approval shall be required and handled in line with the rules and regulations of construction land.

Price concessions. For those major grain and cotton-growing places and key areas of air pollution prevention and control, the electricity bill of collection, baling, cutting, chopping, briquette and other preliminary processing procedures of straws shall be included into electricity price policy concerning agricultural activities, thus lowering the processing cost.

Investment in scientific research. The Central Finance adopted “National High-tech R&D Program (863 Program)”, “National Key Basic Research Development Program” and “National Sci-tech Supporting Program”, which covers the research projects of comprehensive utilization of the crop straws in the hope of improving the efficiency of straw utilization in companies and reducing environmental pollution and waste of resources. In July, 2012, NEA issued “the 12th Five-year Plan” for Biomass Development (issue No.216 [2012] by Department of New Energy of NEA), requiring to vigorously promote the industrialization demonstration of the industry which mainly produces bio-ethanol with residues from agriculture and forestry (cellulose) (see table 5).

Table 5 Preferential policies for the utilization of crop straws

<table>
<thead>
<tr>
<th>Preferential Policies</th>
<th>Year</th>
<th>Name</th>
<th>Target group</th>
<th>main content</th>
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<td>Assistance fund and awards</td>
<td>2008</td>
<td>Interim Measures on the Administration of the Subsidies for the Utilization of Crop Straws</td>
<td>enterprises which produce SDBF, straw gastification, etc.</td>
<td>give overall subsidies in line with set standards</td>
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<td></td>
<td>2015</td>
<td>Notice on Launching Pilots of Comprehensive Utilization of Crop Straws and Improving the Quality of Arable Land</td>
<td>Main bodies engaged in the key areas and links of the comprehensive utilization of straws</td>
<td>substituting awards for subsidies</td>
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<tr>
<td>Tax incentives</td>
<td>Notice of State Administration of Taxation of Ministry of Finance on Value-added Tax Policies for Comprehensive Utilization and other Products</td>
<td>the enterprises which sell power generated with straws as fuel</td>
<td>immediate return of VAT levied</td>
<td></td>
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<td>---------------</td>
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<td>-------------------------------------------------------------</td>
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</tr>
<tr>
<td>Notice of State Administration of Taxation of Ministry of Finance on Value-added Tax Policies for Comprehensive Utilization and other Products</td>
<td>The enterprises engaged in generating power or heating or processing wood products with crop straws and husk as major materials</td>
<td>The taxable income can be calculated on the basis of 90% of the total income and 10% deducted</td>
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<tr>
<td>Catalogue of Value-added Tax Preferences for the Products and Services of the Comprehensive Utilization of Resources</td>
<td>Tax-payers who sell self-produced products pertaining to comprehensive utilization of resources and provide labor services of this area</td>
<td>immediate return of VAT levied</td>
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<td>Catalogue of Value-added Tax Preferences for the Products and Services of the Comprehensive Utilization of Resources</td>
<td>straw pulp and paper production enterprises</td>
<td>50% tax rebate percentage</td>
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<td>Subsidies</td>
<td>Notice on Accelerating the Promotion of Burning Prohibition and Comprehensive Utilization of Crop Straws</td>
<td>main bodies engaged in straw organic fertilizer, straw returning to the field, animal farming with straws and other projects of comprehensive utilization of straws</td>
<td>Financial subsidies</td>
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<td>Financial credit</td>
<td>Notice on Accelerating the Promotion of Burning Prohibition and Comprehensive Utilization of Crop Straws</td>
<td>Enterprises engaged in collection, storage and processing of straws</td>
<td>Financial credit support</td>
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<td>Land use</td>
<td>Notice on Accelerating the Promotion of Burning Prohibition and Comprehensive Utilization of Crop Straws</td>
<td>Main bodies which need land to store straws</td>
<td>Management of interim land use, the review and approval of the permanent appropriation of construction land.</td>
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<tr>
<td>Price concession s</td>
<td>Notice on Accelerating the Promotion of Burning Prohibition and Comprehensive Utilization of Crop Straws</td>
<td>main bodies of collection, baling, cutting, chopping, briquette</td>
<td>include into electricity price policy concerning agricultural activities</td>
<td></td>
</tr>
<tr>
<td>Investment in scientific research</td>
<td>“National High-tech R&amp;D Program (863 Program)”, “National Key Basic Research Development Program” and “National Sci-tech Supporting Program”</td>
<td>programs which include the utilization of crop straws</td>
<td>Support the scientific research programs</td>
<td></td>
</tr>
</tbody>
</table>

Sorted out by the author

### 3.2 Preferential policies for the utilization of animal manure

As for the utilization of animal manure, according to “the 12th Five-year Plan” for National Prevention and Control of Contamination Caused by Livestock and Poultry Farming issued by MOA in November, 2012, the support policies for the comprehensive utilization of the waste from livestock and poultry farming shall be formulated and put into practice. Besides, the local governments are required to carry out the preferential policies of credit, taxation, and subsidies for the construction of commercial biogas facilities, organic fertilizer production and other comprehensive utilization projects in this field. Here is the overview of these policies:

Assistance fund and credit support. In April, 2011, MOF, NEA and MOF jointly issued Interim Measures on the Administration of Subsidies for the Construction of the Green Energy Demonstration Counties (issue No.113 [2011] by Department of Economic Construction, MOF), pointing out that China will appropriate funds to
support the construction of green energy demonstration counties and take such measures as financial assistance, substitution of awards for subsidies and soft loans to support these projects which meet the requirements and expected objectives such as centralized biogas supply projects, biomass gasification projects, BMF projects. In addition, the local fiscal departments should also provide relevant financial support.

Government subsidies. In October, 2010, the General Office of MOA issued Technical Models for Arable Land Quality Protection and Improvement (issue No.39 [2014] by the General Office of MOA), proposing to grant a subsidy of 50 yuan per mu to those farmers, scale growers, professional cooperatives and large-sized farms who use commercial or water-logged composting organic fertilizers made from animal manure when growing grain crops.

Price concessions. According to the Order No. 643 Ordinance of Prevention and Control of Contamination Caused by Scale Farming of Livestock and Poultry issued by the State Council, those who use residues from animal husbandry to manufacture organic fertilizers shall enjoy fertilizer transport capacity support and other support policies. China encourages the application of waste from animal farming for biogas power generation. The excess electricity after self-efficiency should be connected to the power grid. The power grid enterprises should, in accordance with the relevant laws and regulations, provide non-discriminate grid access service for biogas electricity suppliers and fully purchase the excess electricity which is within the range of the area their grids cover and meets the technical standards of connection. Those who use animal farming waste for biogas power generation shall enjoy on-grid power price concessions under the law and those who use animal farming waste to ferment biogas or to produce natural gas can enjoy preferential policies for new energy (see table 6).

### Table 6 Preferential policies for the utilization of animal manure

<table>
<thead>
<tr>
<th>Preferential policies</th>
<th>Year</th>
<th>Name</th>
<th>Target groups</th>
<th>Main contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall support</td>
<td>2012</td>
<td>“the 12th Five-year Plan” for National Prevention and Control of Contamination Caused by Livestock and Poultry Farming</td>
<td>the construction of commercial biogas facilities, organic fertilizer production and other comprehensive utilization projects in this field</td>
<td>credit, taxation, and subsidy preferential policies</td>
</tr>
<tr>
<td>Assistance fund and credit support</td>
<td>2011</td>
<td>Interim Measures on the Administration of Subsidies for the Construction of the Green Energy Demonstration Counties</td>
<td>the construction of green energy demonstration counties</td>
<td>financial assistance, substitution of awards for subsidies and soft loans</td>
</tr>
<tr>
<td>Government subsidies</td>
<td>2014</td>
<td>Technical Models for Arable Land Quality Protection and Improvement</td>
<td>those farmers, scale growers, professional cooperatives and large-sized farms who use commercial or water-logged composting organic fertilizers made from animal manure when growing grain crops</td>
<td>grant a subsidy of 50 yuan per mu</td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>Ordinance of Prevention and Control of Contamination Caused by Scale Farming of Livestock and Poultry</td>
<td>Those who use residues from animal husbandry to manufacture organic fertilizers</td>
<td>enjoy fertilizer transport capacity support and other support policies</td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>Ordinance of Prevention and Control of Contamination Caused by Scale Farming of Livestock and Poultry</td>
<td>Those who connect the excess electricity after self-efficiency to the power grid</td>
<td>fully purchase the excess electricity which is within the range of the area their grids cover and meets the technical standards of connection</td>
</tr>
</tbody>
</table>

21
Ordinance of Prevention and Control of Contamination Caused by Scale Farming of Livestock and Poultry

Ordinance of Prevention and Control of Contamination Caused by Scale Farming of Livestock and Poultry

Sorted out by the author

3.3 Preferential policies for the recycling of plastic films and pesticide packaging from agriculture

As for the utilization of the waste agricultural plastic films, MOA issued *Proposal of Ministry of Agriculture for further Promotion of Emission Reduction and Energy Conservation in Agricultural and Rural Areas* in December, 2011, stipulating that China shall speed up the promotion and application of the technological facilities for picking waste mulch films, grant subsidies to farmers who recycle those films to encourage and guide farmers to do this. Besides, China shall also support the construction of a sound network for the processing of those recycled mulch films, thereby forming a complete recycling chain of waste mulch films. In February, 2015, MOA issued *Proposal for Doing a Good Job in Agricultural and Rural Economy 2015*, pointing out that the local governments should actively implement the *National Agriculture Sustainable Development Plan* and the *Overall Plan for Governance of major issues of Agricultural Environment*, vigorously develop agriculture circular economy, build regional demonstration zones of the utilization of crop straws and animal manure as well as the recycling of waste mulch films in farmland, and promote the implementation of relevant fiscal and taxation policies.

As for the recycling of the pesticide packaging, MEP issued *Measures on the Administration of the Recycling of Pesticide Packaging Waste (on trial)* in April, 2015, offering support to the enterprises which recycle, dispose and reuse the pesticide packaging waste. And *Proposal for Doing a Good Job in Agricultural and Rural Economy 2015* also put forward that subsidy pilots should be set up for the green pest prevention and control and the recycling of pesticide packaging waste (see table 7).

Table 7 Preferential policies for the utilization of agriculture films and pesticide packaging waste

<table>
<thead>
<tr>
<th>Preferential policies</th>
<th>Year</th>
<th>Name</th>
<th>Target groups</th>
<th>Main content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidy for agricultural plastic films</td>
<td>2011</td>
<td>Proposal of Ministry of Agriculture for further Promotion of Emission Reduction and Energy Conservation in Agricultural and Rural Areas</td>
<td>farmers who recycle those films</td>
<td>subsidy</td>
</tr>
<tr>
<td>Financial support for agricultural plastic films</td>
<td>2011</td>
<td>Proposal of Ministry of Agriculture for further Promotion of Emission Reduction and Energy Conservation in Agricultural and Rural Areas</td>
<td>network for the processing of those recycled mulch films</td>
<td>financial support</td>
</tr>
<tr>
<td>Fiscal and taxation policies for agricultural plastic films</td>
<td>2015</td>
<td>Proposal for Doing a Good Job in Agricultural and Rural Economy 2015</td>
<td>regional demonstration zones of the recycling of waste mulch films in farmland</td>
<td>the implementation of relevant fiscal and taxation policies</td>
</tr>
</tbody>
</table>
II. Policy implementation and creation of the local governments

In recent years, the local governments, for the purpose of implementing the national policies for the utilization of agricultural organic residues, have worked out a series of rules and regulations and administration measures. Here are some typical examples, including the utilization of crop straws in Anhui province and the prevention and control of animal husbandry contamination as well as the utilization of animal manure in Zhejiang province.

1. Policies and measures for the utilization of crop straws in Anhui province

Anhui, known as a big agricultural province in China, is a major wheat-growing area, rice and maize. In 2015, the amount of major crop straws totaled 44.4 million tons, with the comprehensive utilization rate reaching 58.4%. Straw returning to the farmland, straw feed, straw base materials and industrial power generation are the main ways to utilize those straws. Anhui mainly enhances the straw utilization by strengthening supervision of straw burning, providing the technological support and increasing policy support.

1.1 Strengthen supervision of the straw burning

It mainly includes four aspects:

Improve regulations. According to the Regulations of the Protection of Eco-agricultural Environment in Anhui Province enacted in 1999, the comprehensive utilization of crop straws shall be further studied and developed. Various forms of the comprehensive utilization of straws shall be vigorously promoted and open burning and abandonment of the crop straws into water shall be prohibited. Law enforcement of straw burning prohibition shall be carried out in accordance with these regulations.

Strengthen publicity. Each year when the harvest seasons come, Anhui will use radio, TV, newspaper and media to educate people with hazards of burning crop straws and tell them how to comprehensively utilize straws and what benefits they get. Besides, Anhui also exposes negative cases to lift people’s awareness of the importance of straw comprehensive utilization.

Strengthen supervision and law enforcement. Each year during the harvest seasons, departments of Environmental Protection, Public Security and Transport will jointly organize an inspection team to oversee the straw burning activities. Departments of provincial, municipal and county levels will organize a law enforcement team for straw burning prohibition. Local governments at municipal, county (district), town (street offices) and village levels will appoint inspection teams and departments at county level undertaking administration of certain villages, together with township (street offices) cadres will also organize inspection teams so as to keep an eye on spot around the clock. Once someone burns straws, he will be stopped and punished. Those who seriously violate laws, cause eco-environmental
degradation or major pollution accidents, cause hug loss of people’s properties, or lead to casualties shall be investigated and be accountable for criminal liability.

Carry out award activities for straw burning prohibition. The governments at each level organize competition activities. For those towns and administrative villages where there is no straw burning all year round and which perform well in the utilization of the straws, the governments will give appropriate awards to them.

1.2 Improve mechanisms and strengthen the utilization of crop straws

Anhui sets up implementation teams of straw comprehensive utilization projects at all levels. The guiding role is played by the governments while market-oriented operation, business management and society-oriented services are adopted in this field.

Improve the organizations and institutions and clarify tasks and objectives. A leading group, with its office located in the municipal department of environmental protection, is set up by each municipal government and is charged by department leaders. Departments of environmental protection, agricultural machinery, national land resources, science and technology, economic and trade, finance, transport, urban management, public security, inspection, publicity, newspaper agency and so on are all involved in this group. Meanwhile, counties (districts) and development zones also have relevant agencies. Duty agreements were signed by all levels of local governments, so each level of departments has a clear idea on their tasks and objectives. Leaders of counties (districts) and towns (street offices) take responsibilities of specific areas distributed to them.

Identify implementation plans and clear-cut duties. In Anhui, the implementation plans for the utilization of crop straws are formulated on the basis of the actual situation of local places. Each concerning department has its own tasks and duties. For example, the department of agriculture is responsible for the promotion of straw comprehensive utilization technologies and the construction of demonstration zones. The department of agricultural machinery undertakes research and development, demonstration and promotion of technologies and equipment for farming activities as well as organization of the mechanized production of straw comprehensive utilization. The departments of development and reform and finance take responsibilities of giving support for the comprehensive utilization, while the news media mainly take on duties of publicity of exemplary cases and play a part in supervision.

Pursue for technological advancement for efficient utilization of crop straws. The governments adheres to the principle of taking enterprises as the mainstay and technologies as the underpinning force to promote the technological industrialization of utilization of straws and improve the machinery equipment and processing capability. The study of comprehensive utilization methods and technologies of crop straws is listed as one of major special sci-tech research projects. And two specific groups are organized for it. One is “expert technical group” which mainly provides technical training and instruction for the concerned counties, and evaluate, inspect and check the implementation of the projects while the other is “project implementation group” which offers technical training and instruction to the farmers in those areas and in the meantime undertakes design, organization, implementation and summary of the tests.

Set successful examples and popularize them. The governments at each level organize scientists and technicians to promote various forms of technologies such as mechanized straw returning to the farmland, manual covering, high temperature composting, ammoniation, silage and gastification of straws by setting successful examples to attract farmers to join in. In addition, a multi-level and multi-form technical training system is established to help farmers tackle challenges.
1.3 Design support policies and combine them when putting into practice

Awards and subsidies are granted to support straw returning to the farmland, purchase and operation of agricultural machineries, power generation with straws, straw used as the raw material to make fertilizer, feed, base material and BMF and the construction of the collection-purchase-storage system.

Subsidies for straw return to the farmland. Subsidies are granted to mechanized straw return to the field, composting return to the field and moving away from the field. It is 20 yuan per mu for wheat, maize and oilseed rape and 10 yuan per mu for rice. The provincial financial department appropriates 70% subsidy to the three municipalities and nine counties in the north of Anhui, 30% to Hefei, Wuhu, Ma’anshan, Tongling and 50% to the rest areas. The remaining part will be covered by financial departments at municipal and county level. The undertaking percentage will be decided by them, too. The awards and subsidies for provincial state-owned farms will be covered by the provincial financial department. The local lower level governments can grant their own funds in accordance with the actual situation.

Subsidies for the purchase of agricultural machinery. Based on the subsidies granted by the central government for the purchase of agricultural machinery, the governments at various levels in Anhui integrate projects and funds, further superposing subsidies to tractors of over 80 hp (horsepower), machines for straw return or moving away from the field and other specialized facilities. The subsidy for the farm machinery retirement will be continued and farmers are encouraged to purchase large composite machinery to improve their farming equipment.

Subsidies for the preliminary processing of straws. This is realized in the form of reducing its electricity cost. For such preliminary processing as collection, cutting, smashing, baling, and briquettes, the electricity price will be the same as that of agricultural production. And the cost for basic capacity of distribution transformer in the preliminary processing is exempted.

Comprehensive preferential policies for power generation with straws. In June, 2014, the provincial government issued Proposal for Accelerating the Development of the Power Generation with Crop Straws, providing awards and subsidies for the power generation with crop straws. For those newly-built straw power plants which are in conformity with the planned network, the preferential will go as follows: the indexes for construction land and environmental capacity are separately listed by the provincial government instead of being covered by the indexes in the places the projects located with priority given to the indexes of construction land, land for storage of straws and pollutant emission. Besides, the plants can also enjoy exemption of land use tax and common road tolls of straw transport vehicles as well as preferential policies for attracting investment.

In April, 2015, Anhui provincial government issued Notice of the General Office of Anhui Provincial Government of the People’s Republic of China on the Work of Straw Burning Prohibition and Comprehensive Utilization (issue No.20 [2015] by the General Office of Anhui Provincial Government), putting forward that the percentage of crop straws used in straw power plants is aimed to reach 40% or so of the total fuels from 2015 to 2017. The government will also grant subsidies to those straw power plants, but it will be carried out according to the purchase agreement between local governments, state farms and the straw power plants (including those plants which purchase straws across counties) signed as of every April. The subsidy standards will be 50 yuan or so per ton for rice straws, 40 yuan or so per ton for wheat straws, and 30 yuan or so per ton for other crops straws like oilseed rape, maize, beans, etc. They will be granted directly by the financial departments at the county level according to their confirmed actual consumption of straws. For those well-performed plants, awards will be given, while for those plants which fail to meet the standards, the awards and subsidies granted in advance that year will be paid back again.
Subsidies for the comprehensive utilization of straws. In order to encourage animal husbandry with straws, the government offers insurance subsidies to the farmers who keep livestock and poultry like cattle, sheep and pigs, and gives different awards according to their keeping heads of animals readily for selling. Subsidies also go for the activities of straw sheeting and water-logged composting to encourage farmers to use straws and animal manure to compost fertilizer. The cultivation of edible fungi with straws and straw gasification are encouraged, too. Those farmers who use biogas or firewood-saving Chinese kitchen ranges are commended and for the organizations engaged in comprehensive utilization of straws or agricultural machinery services, the financial departments first give credit support when they purchase straw treatment machines. Special funds are distributed to support the construction of straw returning to the field demonstration every year.

2. Policies and measures for the governance of contamination caused by animal husbandry and the utilization of animal manure in Zhejiang province

Known as the earliest province with specific measures on the administration of prevention and control of animal husbandry contamination and emission standards of animal farming industry, Zhejiang boasts compulsory policy tools and economic stimulus measures on the animal husbandry contamination and the utilization of animal manure.

2.1 Local laws and documents in Zhejiang

Since the beginning of the 21st century, Zhejiang has explored a lot on the issue of animal husbandry contamination control and utilization of animal manure under the guidance of the related policies and documents from the central government and promulgated a series of directly-related local laws and documents including Notice on Strengthening Prevention and Control of the Contamination Caused by Livestock and Poultry Farming in 2002, Standards for the Emission of Animal Husbandry in Zhejiang in 2005, Proposal for Deepening Prevention and Control of Animal Husbandry Contamination and Accelerating the Development of Ecological Animal Farming, Environmental Access Standards of Pig Farming in Zhejiang Province and Proposal for Promotion of the Production and Application of Commercial Organic Fertilizers in 2010, Measures on Promotion of the Treatment and Application of Agricultural Residues in Zhejiang Province (the first document at local level which defined the agricultural residues reviewed and approved during the 56th session of the Standing Committee of Zhejiang People’s Government in 2010), and Measures on Prevention and Control of the Contamination Caused by Livestock and Poultry Farming in 2015.

2.2 Mandatory policy tools

The mandatory policy tools for the governance of environmental issues have clear objectives and are highly efficient, but the cost is quite high and it is not easy for the grass-roots governments to supervise. In terms of animal husbandry contamination, the policies are mainly applied for the regional development plan, total amount control and emission standard of animal farming, market access of livestock and poultry farming in scale, adjustment of the cultivating and breeding distribution as well as the environmental supervision. Here is the summary of those policies (see table 8).

**Table 8 Mandatory policy tools in Zhejiang**

<table>
<thead>
<tr>
<th>Policy tools</th>
<th>Legislative bodies</th>
<th>Main content</th>
</tr>
</thead>
</table>

26
sorted out by the author

2.3 Economic stimulus policy tools

Economic stimulus policies are commonly used to prevent and control non-point pollution in the agricultural sector. So far, the policies for the control of contamination caused by animal husbandry in scale mainly include the following three aspects: (1) the production and application subsidies, taxation reduction and financial support to the organic fertilizer industry, the utilization of biogas residue and slurry and other businesses concerning utilization of animal husbandry residues; (2) subsidies for the land transfer and the construction and operation of pollution treatment facilities of the main management bodies which are engaged in planting and breeding at the same time; (3) the mechanism of pollution discharge fees and other ecological compensation mechanisms. Here is the summary of those policies (see Table 9).

<table>
<thead>
<tr>
<th>Table 9 Economic stimulus policy tools in Zhejiang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy tools</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
</tbody>
</table>
| Development plans for animal husbandry | Governments at each level | 1. The areas where the animal husbandry and plant growing are limited or banned are clarified.  
2. The number of the pigs kept was reduced 4 million in 2015. For example, the number of pigs in Jiaxing and Quzhou decreased by 45% and 15% respectively. |
| Emission in animal husbandry | Governments at each level | 1. A total amount controlling system of emission is established. In 2015, the comprehensive utilization rate of animal manure in scale farming reached 97% and that of the biogas and biogas slurry and residue 95%.  
Main breeding bodies | 1. "Concept of scale farming" of different varieties is defined and a set of quantification standard higher than the national ones has been set up. |
| Market access | Main breeding bodies | 1. The construction, renovation and expansion of the farms or farm communities can be done on condition that the farms reach at least the scale which is equals 200 pigs being bred at the moment.  
2. The technologies and facilities for handling the scale farming pollution is detailed out, so is the distribution ratio for the integration of cultivating and breeding, and the index for utilization of residues and of the pollutant emission. |
| Environmental supervision | Governments at each level | 1. The plans of farming prohibition and prior evaluation are strictly carried out. The farms which fail to meet the standards are forcibly demolished or moved out  
2. The farms which cause environmental pollution shall be liable to a fine of not less than 1,000 yuan but no more than 10,000 yuan, and for those which cause serious pollution problems shall be liable to a fine of not less than 10,000yuan but no more than 50,000yuan. |
Support the development of the organic fertilizer industry (Quzhou city)

Production enterprises

1. Subsidy for production: 30 yuan per ton for the enterprises in Quzhou which produce commercial organic fertilizers with the animal manure from the city as the main material and sell more than 500 tons.

2. Subsidy for electricity: the electricity price of these enterprises goes the same as that of agricultural production.
3. Taxation incentive: VAT exemption for the production, wholesale and retail of the commercial organic fertilizers.

the regional collection and treatment enter for dry animal manure

1. The land used for material stacking and unhardened fermentation is managed in line with the standard of the land for agricultural facilities.

Main breeding bodies

1. 100 yuan subsidy per square meter for the building of manure storage house and 15 yuan per ton for the collection of animal manure.

Support biogas power generation (Quzhou city)

Project enterprises

1. Subsidy for the investment in construction of pollution treatment facilities can reach 50%.

2. Subsidy for the sale of products: raise the price of the power generated with biogas which is connected to the power grid to 1.1 yuan, 0.5 yuan higher than the initial price.

3. the farms which cause environmental pollution shall be liable to a fine of not less than 1,000 yuan but no more than 10,000 yuan, and for those which cause serious pollution problems shall be liable to a fine of not less than 10,000 yuan but no more than 50,000 yuan.

Promote the utilization of biogas, biogas slurry and residue (Quzhou city)

agencies of the biogas slurry and residue

1. The machineries for the biogas slurry transport and the handling of the straw returning to the field are listed under the catalogue of subsidies for the agri-machinery purchase in Anhui.

Main breeding bodies

1. The subsidy for the newly-built biogas projects in rural areas is 50% and 10 yuan subsidy for the slag removal and maintenance of the biogas digesters.

support the integration of planting and breeding (Jiaxing city)

Main breeding bodies

1. Family farms, intensive farms and animal farming communities are encouraged to seek ecological consumption land for excretion by renting or signing a contract with the growers. The subsidy for the rent of land for excretion consumption is 50 yuan per mu annually.

Sorted out by the author

III. Conclusion

With the initial construction of the related policies and the promulgation of a series of laws and regulations, department rules, notices and plans, the utilization of the agricultural organic residues now can be carried out accordingly. The local
governments put them into practice by working out relevant local laws, development plans and preferential policies according to their own economic and geographic conditions under the guidance of the policies from the central government.

The policies and systems are being improved. On the one hand, China is placing increasingly more emphasis on the utilization of the agricultural organic residues by valuing structural optimization and “green development” instead of economic growth only. Of particular note is that a large number of policies and measures concerning this area have been introduced since the beginning of “the 12th Five-year Plan”. On the other hand, the philosophy of the policies in this field has changed. The way to tackle the pollution problems of agricultural organic residues has changed from “blocking up” to “dredging”. Take the policies for crop straws as an example. We do not exclusively depend on the prohibition of straw burning any more. Instead, we promote the comprehensive utilization of them and then come up with the idea of regional utilization of straws according to the regional disparity of resource distribution.

In spite of the improvement, certainly there are shortcomings which should not be neglected. First, the policies lacks in constancy. Most of current policies are project-oriented. For instance, the policies pertaining to crop straws are mainly about its comprehensive utilization and not consecutively implemented. Second, it is the absence of all-inclusive preferential policies. The support mainly goes to the enterprises for their products of straws and straw power generation while the policies for the collection, storage and transport of straws and the application of the end-products are rarely found, doing no good in forming a complete industrial chain. Third, the fiscal support is inadequate. In some provinces, the subsidy for the pilots of straw return to the field is only 10 to 20 yuan per mu, covering only one third of the real cost. The farmers have to pay the rest by themselves, which makes them unwilling to do that.
Part 3: A comparative study of the utilization of German-Sino agricultural organic residue resource

Contributions by
Prof. Dr. Reiner Doluschitz, Institute of Farm Management, University of Hohenheim, Stuttgart, Germany

(1) The stock status quo of German agricultural residue

According to Fachagentur für Nachwachsende Rohstoffe. Schriftenreihe Nr. 36 (2011) about 93 types of biomass can be distinguished and categorized into five major categories as follows:

- **Wood and other forest products**, such as bark, sawdust, hackschnitzel, a.o.
- **Agricultural by-products and residues**, such as different kinds of straw, residues from vegetables, sugar beet leaves, liquid and solid manure from different kind of animals, a.o.
- **Municipal waste**, such as bio based garbage, different kinds of oil, sewage sludge, a.o.
- **Industrial residues**, such as residues from slaughterhouses, fish, fruit and vegetable processing, different kind of oils, dairy by-products, residues from starch, beverages, sugar, coffee, tobacco, feedstuff production, by-products of pharmaceuticals production, production of yeast and bioethanol, a.o.
- **Residues from non agricultural land**, such as water crop plants, driftwood, extensive grassland use, bio-based materials from maintenance of cultural landscapes, a.o.

Agriculture and Forestry account for about 75% of the total biomass-residue potential in Germany.

In total there is about 151,1 Mill. tons dry matter of biomass-residue potential in Germany. The distribution of different biomass-residue potentials are shown in Tab.1.

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood and other forest products</td>
<td>43%</td>
</tr>
<tr>
<td>Agricultural by-products and residues</td>
<td>30%</td>
</tr>
<tr>
<td>Municipal waste</td>
<td>8%  (+ 4% insecure)</td>
</tr>
<tr>
<td>Industrial residues</td>
<td>9%</td>
</tr>
<tr>
<td>Residues from non agricultural land</td>
<td>3%  (+ 3% insecure)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>


Agricultural residues are biomass residues originating from production, harvesting, and processing in farm areas (Deutsches Biomasse Forschungs Zentrum gGmbH (DBFZ, 2011). They do not include food processing industry residues and usually animal husbandry residues are treated separately. Another option for classification is a distinction according to the stage in the production process or cycle. Such categories would include primary, secondary, and tertiary residues. Primary residues originate from the first step within the production cycle, e.g. harvest of the primary raw material. Secondary residues originate from follow up processing levels, and tertiary residues are to be expected after final consumption (Hoogwijk, M., 2003).
The following categories of agricultural residues commonly are distinguished: **Straw** as a typical by-product of the production of threshed grains, legumes, and oil seed. **Liquid manure**: mixture of solid and liquid excrements of agricultural animals. **Solid manure**: more solid mixture from solid and liquid excrements and bedding material.

(Source: Leibnitz, E., (Hrsg.): *Brockhaus-abc Landwirtschaft*; Brockhaus VEB, Leipzig, 1974, Bd. 2)

In the study of Deutsches BiomasseForschungsZentrum gGmbH (DBFZ, 2011) different categories of potentials are considered. Such potentials can be defined as follows:

<table>
<thead>
<tr>
<th>Potential Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical potential</td>
<td>Theoretically physically usable energy supply within a certain region and a certain timeframe</td>
</tr>
<tr>
<td>Technical potential</td>
<td>Theoretical potential under limitations due to technical restrictions, such as harvest and conversion losses</td>
</tr>
<tr>
<td>Economic potential</td>
<td>Share of technical potential which can be used under positive cost-benefit considerations</td>
</tr>
<tr>
<td>Sustainable biomass potential</td>
<td>Economic potential under the restriction of considering ecological patterns more intensively</td>
</tr>
<tr>
<td>Tap potential</td>
<td>Final share of energy production</td>
</tr>
</tbody>
</table>

Table 2 demonstrates the average yearly potentials and amounts of agricultural residues over the period 1999 - 2007 according to the above mentioned categories and differentiated in crop harvest, animal husbandry and processing.

**Tab. 2: Average annual amount of different types of agricultural residues over the period 1999 - 2007 in Germany**

<table>
<thead>
<tr>
<th>Agricultural residue</th>
<th>Amount (Mill. t per year)</th>
<th>Traditional utilization so far</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fresh material</td>
<td>Dry matter</td>
</tr>
<tr>
<td>Straw from grains (winter and summer wheat, rye, winter and summer barley, triticale, oats)</td>
<td>30</td>
<td>25,8</td>
</tr>
<tr>
<td>Rape seed straw</td>
<td>7,5</td>
<td>6,4</td>
</tr>
<tr>
<td>Maize straw</td>
<td>4</td>
<td>3,1</td>
</tr>
<tr>
<td>Residues from potatoes and sugar beet</td>
<td>19</td>
<td>3,1</td>
</tr>
<tr>
<td>Rape seed cake</td>
<td>3</td>
<td>2,7</td>
</tr>
<tr>
<td>Liquid manure from cattle and swine</td>
<td>122</td>
<td>12,2</td>
</tr>
<tr>
<td>Solid manure from cattle and swine, horses, sheep, poultry</td>
<td>75</td>
<td>7,5</td>
</tr>
</tbody>
</table>

Deutsches BiomasseForschungsZentrum gGmbH (DBFZ): Schriftenreihe des BMU-
It has to be mentioned that the share of liquid (and solid) animal manure with respect to fresh material is quite high. However, the dry matter share is much lower due to high water content, 88 - 97 % for liquid and 40-75 % for solid manure.

Figure 1 indicates the proportions of bio-based agricultural residues from different categories and it can be seen that straw from different grains accounts about 40 % of the overall potential. In total, about 61 Mill. t of dry matter agricultural residues become produced annually in Germany.

On average about 29.8 Million tons fresh matter of grain straw are growing in Germany which accounts to about 48 dt per ha.

**Fig. 1: Amount of dry matter agricultural residues in Germany (annual averages for the period of 1999 - 2007)**


Fig. 2 shows the uneven distribution of grain straw production in Germany, at county level. Regions with high proportions of fertile arable land show much higher amounts than regions with lower quality arable land and higher shares of grassland. Other factors with impact on the amount of straw in a certain region include soil and climatic conditions, relief of the land, crop rotations and density of agricultural livestock.
Fig. 2: Amount of grain straw at county level (tons fresh matter)

Source: Deutsches BiomasseForschungsZentrum gGmbH (DBFZ): Schriftenreihe des BMU-Förderprogramms „Energetische Biomassenutzung“, BAND 2: Basisinformationen für eine nachhaltige Nutzung landwirtschaftlicher Reststoffe zur
Bioenergiebereitstellung. 2011.

Tab. 4: Amount of organic manure in the Federal States of Germany

<table>
<thead>
<tr>
<th>Federal State</th>
<th>Organic manure from animals (1.000 t DM)</th>
<th>Sewage sludge (t DM)</th>
<th>Application (t DM / ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schleswig-Holstein</td>
<td>1,524</td>
<td>61.787</td>
<td>2,55</td>
</tr>
<tr>
<td>Niedersachsen</td>
<td>4,295</td>
<td>140.873</td>
<td>2,51</td>
</tr>
<tr>
<td>Nordrhein-Westfalen</td>
<td>2,176</td>
<td>101.133</td>
<td>2,22</td>
</tr>
<tr>
<td>Hessen</td>
<td>774</td>
<td>49.641</td>
<td>1,76</td>
</tr>
<tr>
<td>Rheinland-Pfalz</td>
<td>542</td>
<td>63.532</td>
<td>1,63</td>
</tr>
<tr>
<td>Baden-Württemberg</td>
<td>1,745</td>
<td>7.604</td>
<td>2,20</td>
</tr>
<tr>
<td>Bayern</td>
<td>4,929</td>
<td>56.712</td>
<td>2,46</td>
</tr>
<tr>
<td>Saarland</td>
<td>73</td>
<td>6.818</td>
<td>2,18</td>
</tr>
<tr>
<td>Brandenburg</td>
<td>886</td>
<td>18.591</td>
<td>0,95</td>
</tr>
<tr>
<td>Mecklenburg-Vorpommern</td>
<td>862</td>
<td>32.333</td>
<td>0,85</td>
</tr>
<tr>
<td>Sachsen</td>
<td>635</td>
<td>8.645</td>
<td>0,95</td>
</tr>
<tr>
<td>Sachsen-Anhalt</td>
<td>663</td>
<td>15.701</td>
<td>0,71</td>
</tr>
<tr>
<td>Thüringen</td>
<td>582</td>
<td>17.791</td>
<td>1,01</td>
</tr>
<tr>
<td>Berlin, Bremen, Hamburg</td>
<td>24</td>
<td>0</td>
<td>3,48</td>
</tr>
<tr>
<td>Germany</td>
<td>19,710</td>
<td>581.161</td>
<td>1,79</td>
</tr>
</tbody>
</table>


The amount of organic manure is also varying within Germany. Regions with high density and concentration of livestock show higher levels in amount and in application (tons per ha). Schleswig-Holstein, Niedersachsen (Lower Saxony), Bavaria, Nordrhein-Westfalen und Bayern (Bavaria) are high level regions with respect to organic manure application. These Federal States are characterized by high densities in agricultural livestock.
Großvieheinheiten (GVE) 2010 auf LAU2 Ebene
je ha LF

- ≤ 0,5
- > 1,0 bis 1,5
- > 1,75 bis 2,0
- > 0,5 bis 1,0
- > 1,5 bis 1,75
- > 2,0
Milchproduktion in kg je ha LF (2013)

Abb. 1: Nutzviehbestände nach GVE in den deutschen Bundesländern 2010

Quelle: Statistisches Bundesamt 2011
Nitrat im Grundwasser

Gebiete in Deutschland, die aufgrund hoher Nitratwerte den sonst guten chemischen Zustand des Grundwassers verfehlen.
Belastetes Trinkwasser in Deutschland - Es stinkt zum Himmel
(2) The utilization methods of German-Sino agricultural organic residue resource

Table 2 above indicates the traditional utilization of different categories of agricultural residues. It can be seen that traditionally only a small portion of grain straw is utilized for energy production. Significant portions become used for humus reproduction and as input into animal husbandry systems. Rapeseed-, maize-straw become used to about 100 % for humus reproduction as well as residues from potatoes and sugar beet. Rapeseed cake is mostly used as feedstuff for animals. Major portions of liquid and solid manure became used as organic fertilizers for arable crop production and grassland.

The use of agricultural residues as solid fuels is currently rather small. There are some niches in which agricultural residues become used, such as strawberry and mushroom production or as insulation material (Deutsches BiomasseForschungsZentrum gGmbH (DBFZ), 2011).

The share of agricultural residues which becomes used for energy production has been increasing in recent years. Biogas plants dominate the transformation to energy from bio-based products so far. About 12 % of liquid and about 3 % of solid animal manure becomes converted in biogas plants.

In future there seems to be potential for larger amounts of biomass becoming utilized for energy production:

<table>
<thead>
<tr>
<th>Agricultural residue</th>
<th>Future potentials for energy production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid and liquid manure</td>
<td>Biogas</td>
</tr>
<tr>
<td>Straw</td>
<td>Biogas; innovative bio-based fuels</td>
</tr>
<tr>
<td>Other post harvest residues</td>
<td>Biogas or Biomass to Liquid (BtL)</td>
</tr>
</tbody>
</table>
(3) The main existing problems of this resource utilization in Germany

Increasing attention to organic agricultural residues has been initiated during the last decades when these residues became considered as resources for bio-based energy production. Respective technologies have been developed for conversion of organic agricultural residues into gas, fuel or heat. Since these developments are rather new there still is high level dynamics in the fields of technology development and implementation, technical progress and innovations, market consolidation and adjustment of suitable policy interventions.

Major existing problems are reflecting this early stage development:

1. The overall potential of organic agricultural residues utilized for energy production is still developed to a low extent so far in Europe.
2. Respective logistics and other infrastructures are built up only partially and are far away from complete coverage.
3. The economic performance with and without specific subsidies is still not fully investigated and cost-benefit-considerations still have to be completed.
4. Risk considerations have been implemented only to a low extent so far; major risks include technology, market, and policy risks.
5. Depending on different origins and supply chains organic agricultural residues often are mixed; however, some utilization and/or conversion alternatives require pure material; therefore, mixed products need re-separation which in some cases is quite costly.
6. Disadvantages of small scale conversion technologies for manure include comparably high investments and ask for costly logistics.
7. In general, straw can be used for various decentralized utilization alternatives; however, respective markets are still under development and weak so far.

Further attention has to be paid to the solution of these problems and respective interdisciplinary research is needed as well as development of suitable policy measures for a more targeted intervention, fostering a sustainable development concerning the beneficial utilization of organic agricultural residues.

(1) The overall potential of organic agricultural residues utilized for energy production is still developed to a low extent so far in Europe.

On the first hand, the quantity of different agricultural residues has to be quantitatively measured (fresh and dry matter). A respective documentation system has to be developed, implemented and applied on a regular basis. Such systems should be harmonized and applied throughout the entire European Union. This kind of systems would allow to build up infrastructures and facilities along different supply-chains and -networks for different utilizations of organic residues from agricultural sources. Predictions of future developments would also become possible.

(2) Respective logistics and other infrastructures are built up only partially and are far away from complete coverage.

This is due to comparably high levels of insecurity and risk due to insufficient knowledge and information. In addition, changes and adjustments in respective policies are additional sources for insecurity and risk. Since the construction of logistics and appropriate infrastructure require long-term investments, stability in supply, demand, market regulation and policies is highly needed. In addition, a database has to be established. Among other items this should include quantitative data of supply, demand, regional allocation and concentration, and information about utilization.
(3) The economic performance with and without specific subsidies is still not fully investigated and cost-benefit-considerations still have to be completed. Partially dependent of above mentioned market and policy insecurities and risk, particularly policy and subsidy changes, are impediments for solid and proper economic cost-benefit calculation. Such calculation need a solid data base, including quantitative patterns on supply, demand, regional allocation (transport costs) and utilization options of different kind of organic residues from agriculture.

(4) Risk considerations have been implemented only to a low extent so far; major risks include technology, market, and policy risks. As already mentioned above such risks predominantly origin from lack of knowledge, information, and data and become even more severe due to insecurities and instabilities over time concerning determinants from markets, policy, and technology-development.

(5) Depending on different origins and supply chains organic agricultural residues often are mixed; however, some utilization and/or conversion alternatives require pure material; therefore, mixed products need re-separation which in some cases is quite costly. A major prerequisite to estimated the respective amount of materials would be a solid data collection and data base, including quantitative statements of supply and utilization of different kind of organic residues from agricultural sources.

(6) Disadvantages of small scale conversion technologies for manure include comparably high investments and ask for costly logistics. Due to a low extent of taking advantage of cost-degression, small scale conversion technologies show a lower competitiveness with respect to cost-benefit considerations. Collection and concentration of materials and conversion by large scale technologies would generally solve this problem of lacking economic performance and low degree of competitiveness. However, environmental issues (e.g. increasing transportation traffic) and hesitations and retentions by local society might increase as well with respect to large scale conversion plants. That means that compromises have to be found between economic performance and competitiveness on the one hand and broad acceptance and environmental tolerance on the other hand.

(7) In general, straw can be used for various decentralized utilization alternatives; however, respective markets are still under development and weak so far. As mentioned before, sufficient data on supply, demand, regional allocation, stable markets and long term policies have to be provided to reduce insecurities and risks originating from markets, policy and technology development. Currently, the observed dynamics are still too high for determination of a sustainable environment.
(4) German Policy System: Common Agricultural Policy (CAP), Cross Compliance (CC) and Rural Development Policy (RDP) of the European Union

General challenges for agricultural sectors all over the world include security of food and nutrition, food safety, attractive cultural landscapes, biomass production, efficient resource-management, functional habitats and rich biodiversity, climate change, competitiveness, and vital rural areas. These challenges also become addressed by the Common Agricultural Policy (CAP) of the European Union along a strategy called “Europe 2020”. Objectives of respective policies are a viable food production, a sustainable management of natural resources and climate action, and a balanced territorial development. Thus, the reform objectives for the 2014 to 2020 period focus on improved sustainability, enhanced competitiveness, greater effectiveness, and social inclusion.

The course of policies and policy adjustments over the last decades included Price subsidies until 1992 increasing problems (over supply, budget overloads, market distortions, conflicts with market partners). As a consequence, symptoms related solutions (quota systems, land set-aside) and transfer to Direct Payments (MacSharry 1992) have been initiated. This has been followed by a strategy of decoupling (Fischler 2003) with direct payments without production obligations. This policy change had been strengthened and completed by stronger consideration of demands at rural areas (“2nd Pillar”; integrated rural development, modulation). This decoupling strategy had been further developed (Fischer Boel, “Health Check” 2008).

Perspectives beyond 2013 are: From decoupling towards targeting: green, fair, competitive.

EU-CAP 2014-2020 maintains the existence of two pillars, tightens up links between them, introduces a new architecture for direct payments: better targeted, fairer and greener, moves from “decoupling” to “targeting”, links each component to specific objectives or functions.

Pillar 1 of this policy includes multi-purpose payments with seven components

1. Basic payment

2. “Greening” component (for provision of public goods not remunerated by the market)

3. Additional payment for young farmers

4. Redistributive payment (for the first hectares of farmland)

5. Additional income support (specific natural constraints/less favored areas)

6. Coupled payments (linked to specific goods)

7. Simplified system for small farmers (< 1.250 Euro).

[(1) – (3) compulsory; (4) – (7) optional]
Basic Payment Scheme (BPS)

- **Green Direct Payment**
- **Redistributive Payment**
- **Payment for areas with natural or other specific constrain**
- **Payment for young farmers**

To receive this payments, the farmers must meet the Cross Compliance (CC) rules

**What is Cross-Compliance (CC)? (REGULATION (EU) No 1306/2013)**

A set of rules that farmers must observe to receive direct payments and some other forms of supports. The rules cover:
- Food safety
- Public, animal and plant health
- Animal welfare
- Climate, environment and protection the water resources
- The condition in which the farm is maintained

The rules are structured in two components
- Good agricultural and environmental conditions (GAECs)
- Statutory management requirements (SMRs)

The EU support may be reduced if the farmer fails to comply with the rules. The support is reduced based on:
- Proportional to the extent
- Permanence
- Severity and
- Repetition of the specified infringement
**Good Agricultural and Environmental Condition (GAEC)**

Article 6. EC No 73/2009

“Member States shall define, at national or regional level, minimum requirements for good agricultural and environmental condition … taking into account the specific characteristics of the areas concerned, including soil and climatic condition, existing farming systems, land use, crop rotation, farming practices, and farm structures.”

ANNEX II - REGULATION (EU) No 1306/2013

<table>
<thead>
<tr>
<th>GAEC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Establishment of buffer strips along water courses</td>
</tr>
<tr>
<td>2</td>
<td>Where use of water for irrigation is subject to authorization, compliance with authorization procedures</td>
</tr>
<tr>
<td>3</td>
<td>Protection of ground water against pollution</td>
</tr>
<tr>
<td>4</td>
<td>Minimum soil cover</td>
</tr>
<tr>
<td>5</td>
<td>Minimum land management reflecting site specific conditions to limit erosion</td>
</tr>
<tr>
<td>6</td>
<td>Maintenance of soil organic matter level through appropriate practices</td>
</tr>
<tr>
<td>7</td>
<td>Retention of landscape features</td>
</tr>
</tbody>
</table>
**Statutory Management Requirements (SMR) - REGULATION (EU) No 1306/2013 - ANNEX II**

<table>
<thead>
<tr>
<th>SMR</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)</td>
</tr>
<tr>
<td>2</td>
<td>Conservation of wild birds (2009/147/EC)</td>
</tr>
<tr>
<td>3</td>
<td>Conservation of natural habitats and of wild flora and fauna (92/43/EEC)</td>
</tr>
<tr>
<td>4</td>
<td>General principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety (EC No 178/2002)</td>
</tr>
<tr>
<td>5</td>
<td>The prohibition on the use in stock farming of certain substances having a hormonal or thyrostatic action and beta-agonists (96/22/EC)</td>
</tr>
<tr>
<td>6</td>
<td>Identification and registration of pigs (2008/71/EC)</td>
</tr>
<tr>
<td>7</td>
<td>System for the identification and registration of bovine animals and regarding the labelling of beef and beef products (EC No 1760/2000)</td>
</tr>
<tr>
<td>8</td>
<td>System for the identification and registration of ovine and caprine animals (EC No 21/2004)</td>
</tr>
<tr>
<td>9</td>
<td>Regulation laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies (EC No 999/2009)</td>
</tr>
<tr>
<td>10</td>
<td>Regulation concerning the placing of plant protection products on the market (EC No 1107/2009)</td>
</tr>
<tr>
<td>11</td>
<td>Laying down minimum standards for the protection of calves (2008/119/EC)</td>
</tr>
<tr>
<td>12</td>
<td>Laying down minimum standards for the protection of pigs (2008/120/EC)</td>
</tr>
<tr>
<td>13</td>
<td>Protection of animals kept for farming purposes (98/58/EC)</td>
</tr>
</tbody>
</table>
SMR 1 Protection of water against pollution caused by nitrates (91/676/EEC)

Objective: Reduce water pollution caused or induced by nitrates from agricultural sources, and prevent further such pollution.

- Each member defines vulnerable zones where waters are affected by pollution, and waters which could be affected by pollution if the actions in the directive are not followed.
- The vulnerable zones should identify
  - Where waters are affected by pollution and,
  - Where waters could be affected by pollution if the actions in the directive are not followed.
- Members shall establish a program to meet the objectives of the SMR.
- Additionally, the application of land fertilizer shall consider good agricultural practices; including GAEC 1.
- Account for:
  - The slope of the land
  - Ground cover
  - Proximity to surface water
  - Weather conditions and climatic conditions (rainfall and irrigation); Applications to water-saturated, flooded, frozen or snow-covered ground
  - Soil type and condition
  - The presence of land drains
  - Land use and agricultural practices, including crop rotation systems
  - Periods when application of certain types of fertilizer is prohibited
  - That the capacity of storage vessels for livestock manure must exceed the storage requirement through the prohibition period
  - The amount of livestock manure applied to the land each year, including by the animals themselves, shall not exceed 170 kg N per ha.

The Guideline to reduce water pollution caused or induced by nitrates from agricultural sources shall be used as an example how policy instruments become transferred from European to national law. According to LICHTI (2011) the handling of nitrogen-based fertilizers and the storage and bottling of liquid manure, slurry, and solid manure is regulated by two policy instruments: The (1) Nitrate guideline and the (2) Fertilization ordinance (DüV from 1996 and 2006 respectively).


2. The Fertilization ordinance (DüV from 1996 and 2006 respectively) includes regulation for handling substances which are hazardous to water. The linkages between the different ordinances are illustrated in Fig. 3.
Fig. 3: Linkages between the different ordinances related to organic residues from agriculture and other sources (LICHTI, 2011)


As the impact and success of such regulations highly depends on the adoption by decision makers and the transformation into practical production processes, the farmers have to be provided with specific tools which enables them to control the efficiency of fertilizer application at farm level. According to LICHTI (2011) a respective data structure for precise calculations have to provided and implemented in farmers management schemes as follows:

"The fertilization ordinance (DüV) regulates:
1. Best management practices when applying fertilizers, soil additives or plant aids on agricultural used land
2. Reduce the risk of hazardous element inputs into agricultural soils

Then precise principles for application of fertilizers including any kind of organic fertilizer are given:
Prior to the application of more than 50 kg Nitrogen or 30 kg P$_2$O$_5$ the nutritional requirement has to be known (§3 no.3).
Thereby the farmer has to take into account (§3 no.2):
1. the nutrient demand of the crop
2. the available nutrient sources in the soil (preceding crop, catch crop and preceding fertilization)
3. the pH-value and humus content
4. nutrients from other management
5. preceding crop, soil cultivation, irrigation
Also, prior to the application of more than 50 kg Nitrogen or 30 kg P\(_2\)O\(_5\) the available amount of nutrients in soil must be known (§3 no.3):

1. for nitrogen:
   - soil analysis
   - recommendation by the federal authority
   - using analysis of comparable sites (published by federal authorities in agricultural journals)

2. for phosphate:
   - soil analysis must be given not older than 6 years

No application of fertilizers (> 1,5 % N, > 0,5 % P\(_2\)O\(_5\) in DM) on (§3 no.5)

- flooded or water saturated soils
- frozen soils
- soils being covered more than 5 cm with snow
- distance requirements bordering surface waters

The nutrient contents of the fertilizers must be known for phosphate and nitrogen. Phosphorus and nitrogen nutrient contents of fertilizers as well as ammonia contents for organic fertilizers must be known by (§4 no.1):

- prescribed labeling (fertilizer ordinance)
- accredited normative data given by the authority
- determination with accredited laboratory methods
- determined with accredited normative data given by the authority

**But the problem when using normative data is that the nutrient content can vary strongly!**

Especially a variation in nitrogen content of input substrate leads to a high variation of nutrient content in biogas residues. Therefore internal analysis is absolutely essential for precise nutrient calculation.

Fluid organic fertilizers and poultry litter have to be incorporated immediately after application (§4 no.2)

Organic fertilizers are not to allowed to be applied more than 170 kg N/ha

Only in exceptional cases and only on grassland 230 kg N/ha (~2%) (§4 no.2)

Blocking period for fertilizers (excluded solid manure) (§4 no.5):

- 01. November until 31. January on arable land

**N-efficiency**

In addition to give a basis for calculation a table is provided with month of high uptake rates. Following on-field trials the uptake rate of nitrogen derived from organic fertilizers depends highly on the month of application and the crop.

**N-balance**

Farmers have to calculate a nutrient balance for phosphorus and nitrogen used as a key indicator for the estimation of nitrogen efficiency and/or to detect critical environmental loads on farm scale (§ 5,6)

- by determining field-balances and adjusting the balances perennial
For the calculation of the balances an internet tool is being provided by the federal authorities or accredited partners.

Control system and administrative penalties – (REGULATION (EU) No 1306/2013)

“Member States may make use of their existing administration and control systems to ensure compliance with the rules on cross-compliance.”

“Member States shall carry out on-the-spot checks to verify whether a beneficiary complies with their obligations”, including but not limited to cross-compliance. The penalties may be applied at any time of the year when the cross-compliance requirements are not meet, and up to three years after starting from January 1st on the year of the first payment.

The penalties are calculated based on:
- Severity
- Extent
- Permanence
- Reoccurrence of the non-compliance

Non-compliance due to negligence:
- The reduction shall not exceed 5%
- In case of reoccurrence, shall not exceed 15%
- Non-compliance related to public and animal health shall always lead to reduction or exclusion
- Other non-compliance may be sanctioned with a warning if there is a minor severity, extent or duration

Intentional non-compliance
- The reduction shall not be less than 20%
**GAP bis 2020 – nationale Umsetzung**

**Sonder-AMK 4.11.2013**

<table>
<thead>
<tr>
<th>Beispielsbetrieb Bayern</th>
<th>50 ha</th>
<th>LF</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>2019/2020</th>
<th>Euro/Betrieb</th>
<th>Euro/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greening-Prämie</td>
<td>4.250</td>
<td>85</td>
</tr>
<tr>
<td>Basisprämie</td>
<td>8.750</td>
<td>175</td>
</tr>
<tr>
<td>Zuschlag erste ha</td>
<td>1.980</td>
<td>bis 30 ha à 50 €/ha bis 46 ha à 30 €/ha</td>
</tr>
<tr>
<td><strong>Grundsituation</strong></td>
<td><strong>14.980</strong></td>
<td><strong>300</strong></td>
</tr>
</tbody>
</table>

Mögliche Zusatzoption für Einzelbetrieb:
- Junglandwirteförderung: bis 90 ha à 50 €/ha
**Beispielberechnung 2015**

**Junglandwirt, 100 ha**

<table>
<thead>
<tr>
<th>Prämie</th>
<th>€/ha x 100 ha</th>
<th>€</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basisprämie</td>
<td>100</td>
<td>19.000</td>
</tr>
<tr>
<td>Greening</td>
<td>87</td>
<td>8.700</td>
</tr>
<tr>
<td>Förderung der ersten Hektar</td>
<td>50/30/30</td>
<td>1.980</td>
</tr>
<tr>
<td>Junglandwirtezuschlag</td>
<td>44</td>
<td>3.960</td>
</tr>
</tbody>
</table>

**Gesamt: 33.640 €**

---

GAP 2014 – 2020, Tagung der LVK Bremen
Stand: 13. Februar 2014, Änderungen vorbehalten

Dr. Thorsten Hoffmann-Hespos
FB Direktzahlungen
### Prämienübersicht 2015, verschiedene Betriebsgrößen

<table>
<thead>
<tr>
<th></th>
<th>42 ha</th>
<th>86 ha</th>
<th>220 ha</th>
<th>450 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basisprämie 187€</td>
<td>€ 7.980</td>
<td>€ 16.340</td>
<td>€ 41.800</td>
<td>€ 85.500</td>
</tr>
<tr>
<td>Greening 87€/ha</td>
<td>€ 3.654</td>
<td>€ 7.482</td>
<td>€ 19.140</td>
<td>€ 39.150</td>
</tr>
<tr>
<td>Zuschlag</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50€/ha für die ersten 30ha</td>
<td>€ 1.500</td>
<td>€ 1.500</td>
<td>€ 1.500</td>
<td>€ 1.500</td>
</tr>
<tr>
<td>30€/ha für weitere 16ha</td>
<td>€ 360</td>
<td>€ 480</td>
<td>€ 480</td>
<td>€ 480</td>
</tr>
<tr>
<td>Junglandwirtezuschlag **</td>
<td>€ 1848</td>
<td>€ 3.784</td>
<td>€ 3.960</td>
<td>€ 3.960</td>
</tr>
<tr>
<td>Betriebsprämie insgesamt</td>
<td>€ 15.342</td>
<td>€ 29.586</td>
<td>€ 66.880</td>
<td>€ 130.590</td>
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<tr>
<td>Durchschnittl. Prämie/ ha</td>
<td>€/ha  365</td>
<td>344</td>
<td>304</td>
<td>290</td>
</tr>
</tbody>
</table>

* 50 €/ha für die ersten 30 ha, 30 €/ha für die nächsten 16 ha  
** 44 €/ha für die ersten 90 ha
### Entwicklung der Betriebsprämie
Beispielbetrieb 86 ha, Hofübergabe 2011

<table>
<thead>
<tr>
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<tr>
<td>Basisprämie</td>
<td>€/ha</td>
<td>366</td>
<td>325</td>
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<td>Basisprämie Bsp. betrieb</td>
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<td>28.106</td>
<td>27.950</td>
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<td>16.340</td>
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<tr>
<td>Greening</td>
<td>€/ha</td>
<td>87</td>
<td>86</td>
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<tr>
<td>Greening Bsp. betrieb</td>
<td>€</td>
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<td>7.396</td>
<td>7.396</td>
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<tr>
<td>Zuschlag für die ersten 46 ha **</td>
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<td>1.980</td>
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<td>Junglandwirtezuschlag ***</td>
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<td>3.784</td>
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<td>Durchschnittl. Prämie/ ha</td>
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<td>327</td>
<td>348</td>
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<td>343</td>
<td>293</td>
<td>288</td>
</tr>
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</table>

* incl. 10% Modulation, 2,45% Haushaltsdisziplin  
** 50 €/ha für die ersten 30ha, 30 €/ha für die nächsten 16ha  
*** 44 €/ha für die ersten 90 ha

GAP 2014 – 2020, Tagung der LWK Bremen  
Stand: 13. Februar 2014, Änderungen vorbehalten  
Dr. Thorsten Holzmann-Hespos  
FD Direktzahlungen
Literatur


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