REPORT 2ND APD WORKING GROUP MEETING

2016 Beijing, 29.08. - 30.08.2016

Report by DCZ

Content

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1 Agenda and topic

29.08.2016: Farm excursion: Ouhua Farming and Animal Husbandry Co., Ltd, Lang Fang City

30.08.2016: 2nd working group meeting on APD - sustainable agriculture in Beijing

Purpose: An agreement has been reached in the first working group meeting on the 30th May 2016 to further elaborate on the topic:

"Policies and strategies for the reduction of organic residues (straw and manure) from agriculture and their improved use"

A. Regulatory, legal framework and compliance system related to residues management practices
B. Avoidance of wastes through improved production systems? Different organic residue management options (e.g. crop rotation, livestock density, energy, biogas)
C. Specific technical solutions? E.g. manure spreading equipment and alternative machines for straw processing

See detailed program and participation list.

2 Background to the topic organic residues

2.1 Manure

The rapid development of large-scaled and intensive livestock husbandry in China has led to a substantial increase on manure; China produces about 3.8 billion tons of manure every year. Manure mainly comes from cow, pig, sheep/goat and poultry husbandry.

The construction of manure treatment facilities is underdeveloped, a large amount of livestock manure is difficult to be processed and utilized. The comprehensive utilization rate of manure is less than 60%. Livestock manure becomes pollutants instead of being traditional fertilizer.

Pollution caused by livestock manure is an important source of agricultural non-point source pollution. In 2014, COD (chemical oxygen demand) and ammonia nitrogen emissions of scaled livestock husbandry were 10.49 and 0.58 million tons, accounting for 45% and 25% of the national total emissions, accounting for 95% and 76% of total agricultural sources pollution.

Based on household survey, putting manure back to soil is the most common manure use option (73.41%). Manure back to soil is an option of manure resource utilization, but untreated

manure contains a large number of pathogenic micro-organisms and parasites eggs, resulting in negative impact on the environment.

Chinese government has taken measures such as biogas subsidies, organic fertilizer subsidies to guide farmers in manure utilization. From 2001 to 2010, central government subsidies for rural household biogas construction amounted to 18.27 billion RMB. However, the livestock manure disposal rate is still low; the proportion of biogas production is only 1.09%.

Farmers' manure treatment is part of their decision-making behavior to maximize their benefits in consideration of the technique availability, costs and benefits of technique adoption, technique feasibility and related policy.

- Piling up: no investment, simple operation
- Back to soil: simple operation, need land
- Selling manure: no investment, can have economic benefit, but manure market is not completely developed, manure price is low and transport cost is high
- Production of biogas and organic fertilizer: investment is relative huge, technical operation is complicated, farmers depend on subsidy and policy support

2.2 Straw

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 the total output of China's crop straw was 964 million tons, of which 819 million tons were recyclable, actual straw use about 622 million tons, comprehensive utilization rate being 76% in 2013.

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. Many straw utilization technologies become more mature through industrial demonstration, which are important support to promote the comprehensive utilization of straw. 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 was increased from 70.6% in 2010 to 78%, wherein 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 straw unutilized, becoming an important source of pollution to the ecological environment and even water, 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.

3 Field excursion to a pig breeding farm

The delegation visited the Hebei Langfang Ouhua Farming and Animal Husbandry Co., Ltd. The trip was a good starting point to get an insight on the challenges of organic residue management in China.

With 700 sows, 12,000 fattening pigs are produced per year; the owners are two investors, one of which is the managing director who also led us through the farm.

The farm is a Chinese model farm, and accordingly won numerous awards. It has only 28 hectares, of which a considerable part is building and yard area. On their website it is advertised as a partly biologically operated and circular economy farm, although it is operated almost without own fodder production and without own coupled land for the application of manure. Instead almost exclusively feed is purchased from outside and there is a huge surplus of pig manure and slurry available.

The manure is used in a state-subsidized plant partly to produce biogas. The gas is only used for cooking and heating on the farm, and so far no electricity is produced. The biogas production would and could thus be significantly increased. As there is little use for the biogas, a part of the gas is even harmfully discharged to the environment.

There are sales of dried organic fertilizer in plastic bags and liquid fertilizer held in canisters. The quantities produced and the scope of the filling stations seemed compared to the very large volume, which incur on the farm, very small. Maybe manure is disposed of elsewhere in this operation.

The farm shows the problem of land decoupled livestock production and the related disposal of manure with eutrophication very clearly. It also becomes clear, how carelessly and without consequences such large farms are advertised with terms such as biologically and “close to nature”, although this is not justified. It is planned to extend the farm project towards “ecologization".

4 Presentations APD working group meeting

The working group meeting consisted of seven input presentations from German and Chinese experts, followed by in-depth discussion sessions and finalized with an agreement to produce a joint research paper, comparing the different policy approaches towards organic residue management and giving joint policy recommendations.

The presenters were:

Prof. Reiner Doluschitz, University of Hohenheim: Common Agricultural Policy (CAP), Cross Compliance (CC) and Rural Development Policy (RDP) of the European Union (see handout and presentation in Annex)

Dr. Wang Huimin, Research Center for Rural Economy RCRE: Agricultural waste utilization policies and regulations (mainly introduce China Agricultural organic waste emissions, handling

policies and regulations to encourage organic waste utilization of policies and measures) (see presentation in Annex)

Dr. Marco Roelcke, DCZ: Organic residue management options in a Chinese peri-urban region with high livestock densities (see handout and presentation in Annex)

Dr. Yuan Ruiling, Research Center for Rural Economy RCRE: Manure resource utilization options and cost-benefit analysis - A Case Study of Enterprise Survey (see presentation in Annex)

Mr. Horst Bunge, Farm Consultant: Cost-benefit analysis of different alternative sustainable farm level production systems (crop rotations and/or recycling agriculture, integration of livestock) in Northeastern China (see presentation in Annex)

Mr. Thomas Illies, Team leader of Sino-German Crop Production project: Best practice of straw management and specific technical solutions for straw processing (see presentation in Annex)

Mr. Stephan Illi, Organic farming consultant: Residue Management in organic farming – the CMC method for composting (see handout and presentation in Annex)

5 Recommendations

5.1 Lessons learnt from the presentations and discussions

From the presentations and discussions the experts states the following recommendations:

General:

- Objectives of respective agricultural policies should be a viable food production, a sustainable management of natural resources and climate action, and a balanced territorial development.
- There should be a set of rules that farmers must observe to receive "payments" and some other forms of supports (minimum requirements for good agricultural and environmental condition and statutory management requirements)
- The support should be reduced if the farmer fails to comply with the rules
- Policies should be better targeted, fairer and greener: moving from "decoupling" to "targeting", linking each component to specific objectives or functions.
- The income and spill-over effects of different types of payment or subsidy should be taken into consideration, when designing agricultural policies.

Manure[1]:

- As immediate measure, the excessive FYM should be processed and surplus nutrients exported out of the peri-urban region via marketable products

[1] Recommendations were derived from the BMBF funded research project "Recycling of organic residues from agricultural and municipal origin in China" from Sep. 01, 2008 – March 31, 2012

- → Build-up of soil organic matter in outlying areas of the North China Plain with less livestock
- Governmental subsidies to compost production in place for Beijing (since 2011): Subsidized price (2016): 600 CNY per ton (480 CNY from govt., 120 CNY by farmers) Selling price: Up to 1000 CNY per ton
- Differences in farming practices should be taken into account when designing integrated nutrient management strategies on regional scale
- Whether to promote manure processing for nutrient export or to focus on energy production and subsequent technological nutrient removal from effluent, or drying and pelletizing of digestate → decide on case by case basis
- Life cycle assessment: The use of biogas in a CHP plant is more profitable and sustainable than for external use for cooking and heating
- Urgent need for on-farm research on the use of biogas effluent in Chinese cropping systems, considering nutrient as well as emission aspects
- Good composting procedures or high-end biogas plants may become economically attractive without subsidies in the future
- Reduction of livestock densities, by moving part of the landless livestock operations to surrounding provinces closer to the cropland demand, is essential

Straw:

- Straw is a resource and should not be considered a waste product.
- The burning of straw kills the humus potential and contributes to air pollution.
- A bad straw management cannot be repaired by soil cultivation
- High cut decrease harvesting costs but also increases the costs for soil cultivation and sowing. This is convenient in extensive farming regions. After high cut it is strongly recommended to use a mulcher
- It is essential to make the right selection of soil cultivation for following plant growing and good roots development!
- Short cut, good crushing and dividing of straw on the field is a must for good management.
- The correct cultivation of straw mass into the soil supports soil life and staw rotting, decreases evaporation or/and enforces faster infiltration of large water masses.
- A cost-benefit analysis of investments is the right technologies should take into account the farm nutrient value of the straw.

Competitiveness and environmental compatibility:

- The starting point for all system steps in arable farming is always the tillage system

- On top are the economy and the ecology: on the one hand, sustainable soil fertility has to be ensured and, on the other hand, the production of high yields and decent quality at reduced costs
- A balanced wide crop rotation is an important precondition to increase the yield and to reduce the costs.
- Concerning the problems of soil erosion, soil compaction and biological activity of high importance is: the high negative influence of MONOCULTURE
- An overall assessment of various process chains requires more than just considering crop rotation and fertilization systems
- A good indicator for success and progress is the comparison between income and costs. At least a time horizon of 3-5 years is needed.

Recommendations for North East China towards ecological production:

- Climate and soil quality must ensure an ideal basis for developing a livestock breeding (beef, pigs, poultry)
- The required fodder Maize (corn and silage), Soybeans, Wheat, Alfalfa grows already in the northern Provinces of China
- All this products can be produced ecological
- The demand for ecological products is growing
- Ecological farming requires a well-trained management, more than conventional farming
- Only successful farms and Manager should start with ecological farming
- If one starts it in a consequent and controlled way – there is no contradiction between ecology and economics
- An ecological farming depends from the nutrient cycle arable farming and livestock breeding
- Setting up livestock breeding can bring some following economic processing activities
- For more and more enterprises it can be interesting to participate in this ecological development movement
- Offering more jobs especially for small farmers make plans more likely for a bigger structural change
- At least: the transformation offers chances for a higher value-added chain for the farm and consumers

5.2 Further recommendation for APD – view point organic farming

Organic farming (as understood in Germany) is a very good example of a farming system with integrated livestock production. Straw is transformed from a waste product to a

demanding raw material, which through the litter in the shed becomes manure that is then the basis of fertilization and of humus accumulation. In this sense, organic farming could serve as a vision of sustainable circular economy and even more contribute to the subject of organic residues.

Even on an agricultural policy level, the topic organic farming is very up-to-date, as on the one hand the demand for organic products in China exploded, on the other hand soon credibility problems will arise. Because of the various and unclear standards, the more than questionable methods (over-fertilization with conventional manure from factory farms including the respective drug residues) and the entry of large companies that are exclusively driven by profit, will get known by consumers, and in my estimation, will lead to further scandals etc.

In preparation of the possible thread: organic farming in APD it is necessary, to research the following beforehand (coordinated by both sides of the DCZ?):

- Comparison of different Chinese "organic" standards with EU-Bio. What governmental organizations are responsible and support the various standards, where does one work together, where would more collaboration be important?
- Presentation of Chinese control systems and comparison with EU-Bio-control system.
- Detection of quality defects (for example, pesticide contamination) in Chinese organic products (for example, in export (or intended) products to Europe).
- How is Bio promoted in China and EU? Do the eligibility criteria for promotion fit the mission of organic agriculture?
- How does marketing take place? What are the customers' needs? What are trends in the Chinese organic market?
- What are the institutions in research and consulting in China? How do these institutions cooperate with each other? What is the level of consultation in comparison to, for example, Eco-counseling in Germany? Is there any cooperation with the EU and Germany, or how could this be improved? (Know-how transfer)
- Especially interesting, especially for the agricultural policy dialogue, would be the questions:
  How are the recent political conditions affecting the organic farming sector?
  (Example: the monitoring and control system that focuses on individual products such as rice complicates and increase the costs of the establishment of diverse farms, as they correspond to the vision of organic farming. Instead, they promote the (almost) monoculture in organic farming.)
  What changes in the political environment would be useful in China to promote the development of a sustainable and healthy organic farming?

  After the presence of these conditions and relationships a highly fertile dialogue in APD could be possible.

6 Annex

6.1 Handout - Common Agricultural Policy (CAP), Cross Compliance (CC) and Rural Development Policy (RDP) of the European Union

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

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, and 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)

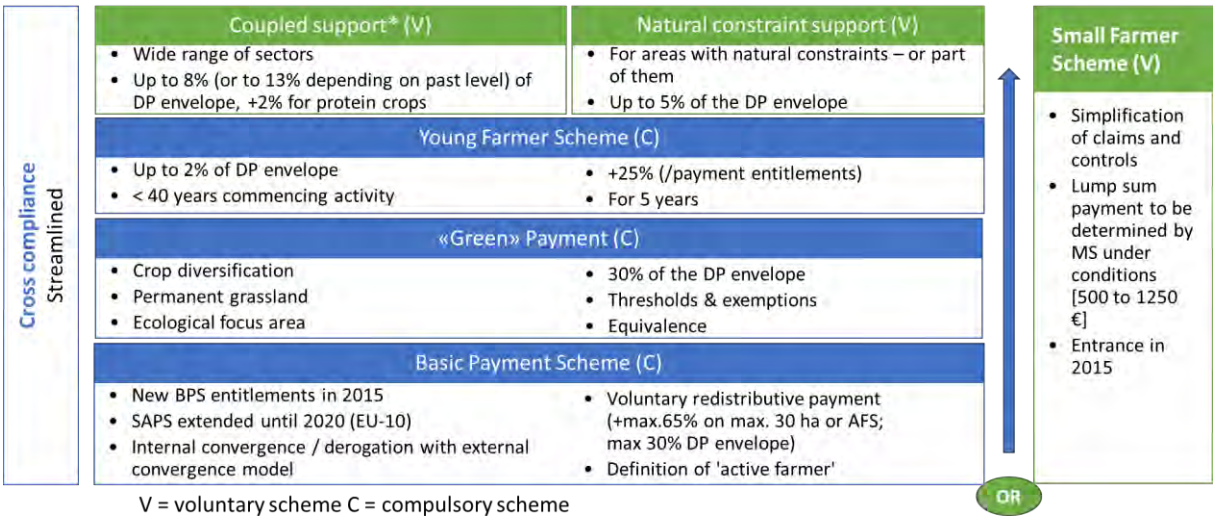
(5) Additional income support (specific natural constraints/less favored areas)

(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)



Modified from (2015) *The CAP towards 2020. Implementation of the new system of direct payments.* Member States' notifications. *DG Agriculture and Rural Development European Commission. Retrieved on 15Jul16. http://ec.europa.eu/agriculture/direct-support/direct-payments/docs/implementation-ms-notifications-slides_en.pdf*

The BPS is a precondition for the farmers to receive

- 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

GAEC	Description
1	Establishment of buffer strips along water courses
2	Where use of water for irrigation is subject to authorization, compliance with authorization procedures
3	Protection of ground water against pollution
4	Minimum soil cover
5	Minimum land management reflecting site specific conditions to limit erosion
6	Maintenance of soil organic matter level through appropriate practices
7	Retention of landscape features

Statutory Management Requirements (SMR) - REGULATION (EU) No 1306/2013 **-** ANNEX II

SMR	Description
1	Protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC)
2	Conservation of wild birds (2009/147/EC)
3	Conservation of natural habitats and of wild flora and fauna (92/43/EEC)
4	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)
5	The prohibition on the use in stock farming of certain substances having a hormonal or thyrostatic action and beta-agonists (96/22/EC)
6	Identification and registration of pigs (2008/71/EC)
7	System for the identification and registration of bovine animals and regarding the labelling of beef and beef products (EC No 1760/2000)
8	System for the identification and registration of ovine and caprine animals (EC No 21/2004)
9	Regulation laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies (EC No 999/2009)

10	Regulation concerning the placing of plant protection products on the market (EC No 1107/2009)
11	Laying down minimum standards for the protection of calves (2008/119/EC)
12	Laying down minimum standards for the protection of pigs (2008/120/EC)
13	Protection of animals kept for farming purposes (98/58/EC)

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 stablish 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.

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%

6.2 Handout - Organic residue management options in a Chinese peri-urban region with high livestock densities[2]

Policy:

- No specialization between crop farming and animal production, integrated systems in agriculture would be preferable.
- "Re-coupling" of animal and plant production needed
- Chinese government should create awareness and ask for an organic fertilizer concept from the animal operation or the biogas plant before giving it environmental permission.

Polluter Pays Principle:

- The producer of waste/wastewater would be responsible for its treatment and utilization
- → Equilibrium; as well as more balanced distribution of livestock densities
- → Also conflict of interests, since the Polluter Pays Principle enforced by the government, which at the same time wants to secure animal production
- Feasible for intensive animal farms, not for small household-scale operations

Export of nutrients vs. improvement of biogas efficiency?

- Export of nutrients in form of transportable and marketable fertilizers
  → e.g. by composting the solid phase of animal excreta

[2] Recommendations were derived from the BMBF funded research project "Recycling of organic residues from agricultural and municipal origin in China" from Sep. 01, 2008 – March 31, 2012

- If energy production as main aim, then high carbon (COD) content in liquid phase preferred → but only C is reduced; more nutrients (NPK) remain in liquid phase or in digestate
- Drying and pelletizing of digestate another option to transport nutrients
- Decisions about technologies/recommendations must be region- and case-specific
- Recommendations should be based on holistic view – animal production, crop farming, energy production, etc.

Recommendations for peri-urban areas in northern China:

- Reduce very high nutrient surpluses and pollutants caused by animal husbandry
- Reduce livestock density of 11 LU per ha in Shunyi District to 3-4
- Nutrients from organic sources should be exported out of the peri-urban region in form of organic fertilizers, to outlying areas in the NCP lower in SOM and with less livestock
- *gan qing fen* system is to be favored
- Storage basins should be sealed

Phosphorus, Potassium:

- Establish optimum plant available P (Olsen) (10-30 mg kg^{-1}, according to crops) and available K (50-100 mg kg^{-1}) contents in soil
- Reduce excessive manure application to cash crops
- P and K derived from FYM is sufficient in most cases
- If FYM available, then apply some to cereal crops (basal fertilization)
- Beginning acidification in topsoils → Reduce mobility of dissolved P in runoff or leachate by adding amendments (such as $CaCO_3$)
- Reduce P content in manure by decreasing P content in feed

Nitrogen:

- Reduce mineral and organic N fertilization
- Nutrients applied (mineral and organic) should not exceed crop removal; N_{min} method

Heavy metals and antibiotics:

- Input reduction required. No routine use of HM and antibiotics as feed additives!
- Risk assessment indispensable
- Loading capacity of soil is limited

Anaerobic digestion (biogas plants):

- Only C is reduced: high loads of N, P, K still remain in the digested effluent
- Good wastewater treatment only very seldom the case in China
- Large-scale centralized biogas plants collect manure from several farms
- Liquid phase may spread diseases → Farmers sometimes do not accept the product
- Technologies to separate nutrients from liquid phase, phosphate precipitation, NH3 stripping
- Liquid manure (slurry) would have much higher transportation costs than compost
- Knowledge on how to store manure for some time must be communicated to farmers
- Storage basins should be sealed

6.3 Handout - Residue Management in organic farming – the CMC method for composting

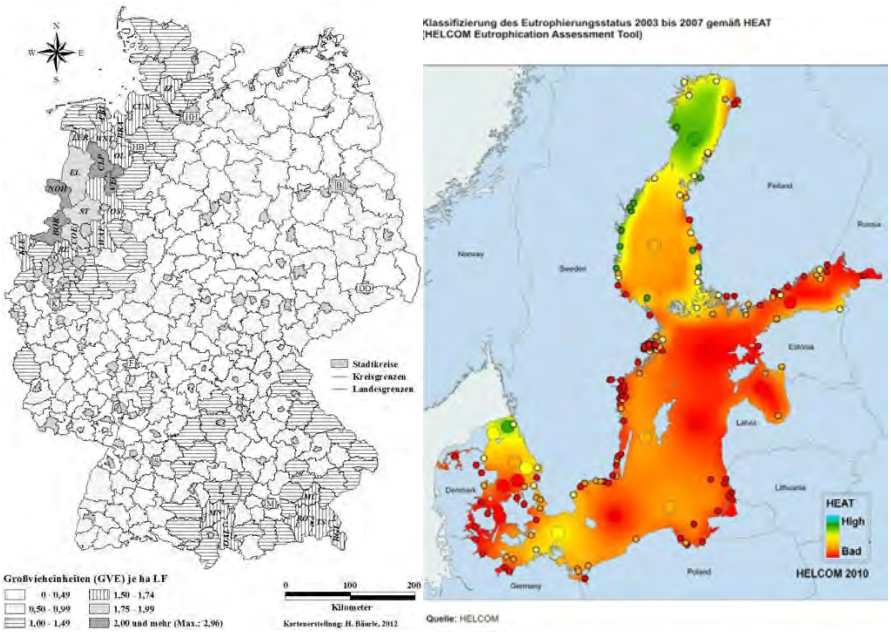
Stephan Illi, August 2016 APD Beijing

China has a 4000 year tradition in residue management

F.H. King (4000 years agriculture in China, Korea and Japan, 1911) documented the methods of sustainable agriculture in China. In an hight developed circulation system nearly no fertilizer went out. Composting of all organic residues makes waste to fertilizer.

Separation of plant production and animal husbandry
Intensification of agriculture increasingly leads to separation of plant production and animal husbandry, in Europe and China.

Mineral fertilizers are used instead of a circulation system with animal. Together with high rates of import of feed does it lead to eluviation of nitrate and phosphate in rivers and sea? In Germany f. i. we have an increasing concentration of nitrate in drinking water



Organic agriculture works with circulation systems

Most organic farmers combine animal husbandry and plant production (exception: f. i. gardening, fruit production). Organic plant production without animal husbandry over many years does not work easily. In Germany it is not possible to buy big amounts of animal dung.

The straw of organic cereals is important for appropriate animal husbandry. Most organic farmers have no export of dung and only few imports of fertilizers. Some organic farmers in a region cooperate together (straw of the cereals producer versus dung of the animal producer).

But: not all (organic) farmers have a good system for organic residue management.

So let´s learn from the best farmers

Example: Josef Braun, organic farmer near Munich

He has 38 ha fields and 17 ha of grassland, 22 cows, is making cheese selling direct to consumers. He keeps pigs (eating the whey) and hens.

He has no import from outside except a bit stone powder.

The farm is working with a nearly closed cycle, including energy (he is selling electricity!)

His special attribute: observe and learn from nature!

Increasing Humus in the soil is possible

Josef Braun was able to raise the percentage of humus from

1,8 % up to 4,5% in 20 years! It is 2,7 % more humus in 20 years!

Science says: that's impossible! Because you need more than 5000 kg more of nitrogen per ha.

In the soil is more than double of the amount of nitrogen as in the air: so it would be possible to fix the overhang of CO_2 of the air (about 0,5-1 % more Humus worldwide would roll back climate change).

4,5 % humus in the soil is the ideal protection against impact of climate change with too much or too few rain!

4,5 % humus makes a high amount of crops possible.

450 worms per m2 are possible

Josef Braun has now 450 worms/m^2, the average in Germany is about 20.

He is working with minimal tillage (only 5 cm), and the worms are doing the tillage work for him.

In the year 2013 he had about 200 l rain/m^2 in 28 hours, all farmers except him had big problems. If all farmers would have so many worms, flooding would not more be a problem, the state could save the money for building higher dams for the rivers.

That´s important for climate change.
Josef Braun works with nearly constantly vegetation for feeding worms. He tillages in the time the worms are not active (too hot or too cold) and only 5 cm.

Agroforestry

Josef Braun planted rows of fast growing trees every 80 m over his fields. Every 6 years he is cutting it and producing woodchips. With a new technology he produces gas from wood, getting worms for the farm and selling electricity.

So it is possible to produce much more energy than with biogas. And the wood coal goes to his composting system raising the humus in the soil.

Agroforestry is able to slow storms, improving micro climate and biodiversity, raising harvest amount. So there is nearly no decrease of overall harvest. Agroforestry could produce one of the most important raw materials for green energy!

CMC-composting

Josef Braun is composting his dung with the CMC method. Controlled microbial composting means that the microbial live can work very fast, so the compost is ready after 6 weeks!

Therefore it is important to

- have the right relation of C and N (1:30)
- have enough (and not too much) water (65 % in the beginning)
- have enough O_2 and not too much CO_2
- have a temperature of not more than 65 °C

It is important to add 10% soil, 10% mother compost (or for he beginning compost starter), and stone-powder. You can use all organic materials (without pesticides and heavy metals).

Weed seed is completely destroyed because of the high temperature. CMC compost helps raising the humus in the soil.

Round the world farmers make very good experiences with CMC. F.i. in Egypt on Sekem farm it was possible to build up fertile soil in the desert. (www.sekem.com).