Urban Europe and NSFC

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UNCNET

Urban nitrogen cycles: new economy thinking to master the challenges of climate change

D5/2: Clear concept of urban agricultural flows

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Dissemination Level		
PU	Public	☒
PP	Restricted to other programme participants (including funding agencies)	☐
RE	Restricted to a group specified by the consortium (including funding agencies)	☐
CO	Confidential, only for members of the consortium (including funding agencies)	☐

1. Executive Summary

The current report describes how to quantify N fluxes using the NUFER model (Developed by CAS) within Shijiazhuang areas. Extending clear concepts developed for urban scale means that some of the structure (mass flow approach) needs to be maintained. Defined pools within extended NUFER model included agricultural land, livestock, urban green, horticulture and pets. Within UNCNET, there will be the need to produce output for the "urban center" as well as the "peri-urban area". Regarding spatial differentiation, this report describes the definition of urban center and peri-urban area of Shijiazhuang (this model simply separates one urban center core and the remaining suburban area). The extended NUFER model introduced here allows to prepare parameter data, differentiate urban center, quantify N flow between pools in urban areas, and compare N flow characteristics between the urban center and the peri-urban area.

2. Objectives:

(1). Identifying the boundaries of urban and peri-urban areas in UNCNET.
(2). Quantifying nitrogen flux that cascades among the 5 different pools through interaction.
(3) Comparing nitrogen characteristics between urban and peri-urban area.

3. Activities:

Define the spatial delineation of urban and peri-urban

Creation of an urban agricultural model

Quantify all nitrogen fluxes and their interactions

4. Results:

A nitrogen flow model of urban agriculture has been established and the N flow result in Shijiazhuang areas has been calculated-see attachment.

5. Milestones achieved:

(1)The nitrogen budget including 5 subsystems within Shijiazhuang has been constructed.

(2)The nitrogen models for urban areas have been constructed, which can be used to calculated N flow for other test cities.

(3) The N flow through Shijiazhuang has been compiled.

6. Deviations and reasons:

Delays have been incurred as a result of COVID-19.

7. Publications:

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8. Meetings:

On-line conference

9. List of Documents/Annexes:

Annex1: Clear concept of urban agricultural flows
Annex2: Parameter list for urban agricultural flows

REFERENCES

Annex 1

Clear concept of urban agricultural flows

Introduction:

UNCNET will use the concept of pools and flows as developed under the UNECE Task Force on Emission Inventories for the urban agricultural nitrogen (N) flow (Fig. 1). The idea is that reactive N is being exchanged between pools in the urban agriculture, with data available on fluxes between the respective pools, and equilibria (allowing for validation) being established within each pool. Also, fixation and loss of molecular nitrogen (unreactive nitrogen) can be implemented as source/sink term. The concept is scalable, also permitting sub-pools, and has been tested successfully on national scale.

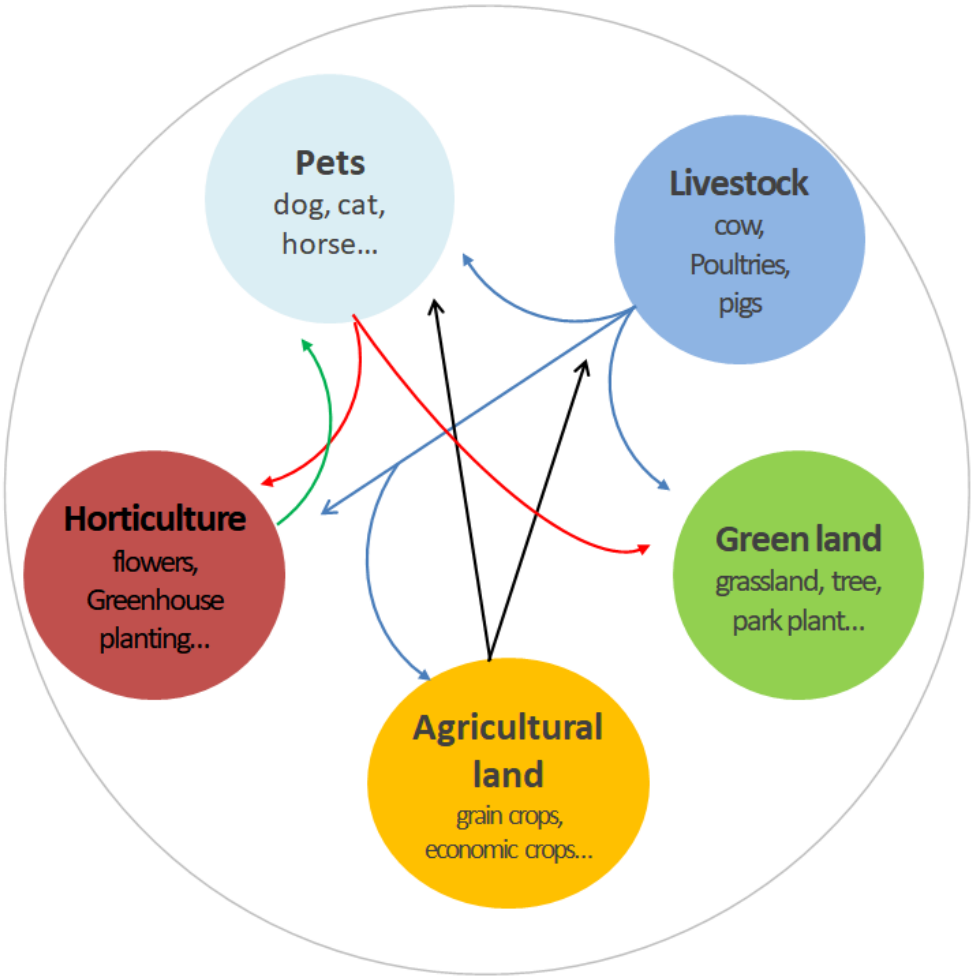

Figure 1 Concept of nitrogen flows in urban agriculture

Model description:

We extended the NUFER model to quantify N fluxes within urban areas (Fig. 2). The NUFER model calculates all nitrogen fluxes and their interactions that can be identified, together with the linkages among subsystems within an urban space. The systems in this study were divided into the following subsystems: agricultural land, livestock, urban green, horticulture and pets. We used this model to synthesize the information for calculating urban and peri-urban budgets for different areas and to evaluate the difference between urban budgets and peri-urban budgets. The model framework in this study is shown in figure 2. The basic principle of the extended NUFER model is the mass balance for each subsystem. In this study, the terrestrial biosphere defined for the study area was limited laterally by the river network, i.e. once water containing nitrogen enters the stream network, it was considered to have left the terrestrial biosphere. In the vertical profile the terrestrial biosphere was taken as being limited by the atmosphere above and the bottom of the soil profile below.

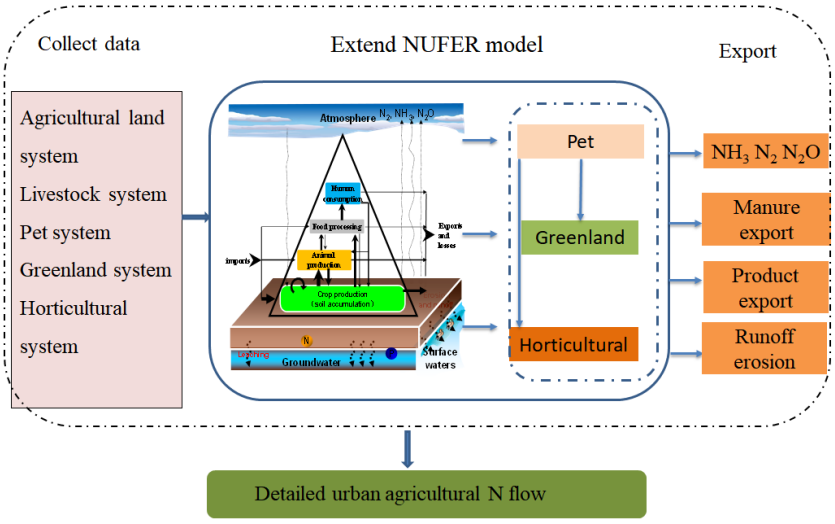

Figure 2 Detailed urban agricultural N flow

Study areas:

Shijiazhuang is the capital and largest city of North China's Hebei Province (Fig. 3). The city had a total population of 12 million with 4 million in the metro area comprising the 7 districts and 12 counties. Within UNCNET and in order to allow comparing with other cities (Beijing, Vienna, Zielona Góra) there will need to have an output both for the center and the peri-urban area. Regarding the spatial differentiation of urban and peri-urban, we use the "one core" approach (simply separating one urban core and the remaining suburban area) to distinguish the central urban areas of Shijiazhuang and the peri-urban areas (Fig. 4).

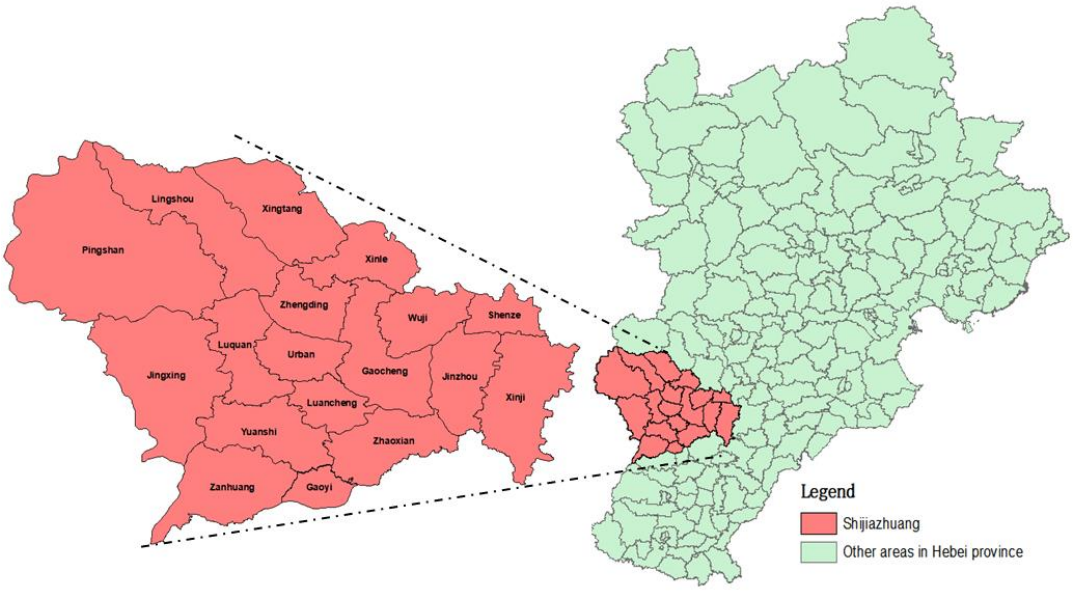

Figure 3 Location of Shijiazhuang city in the Jing-jin-ji area in Northern China

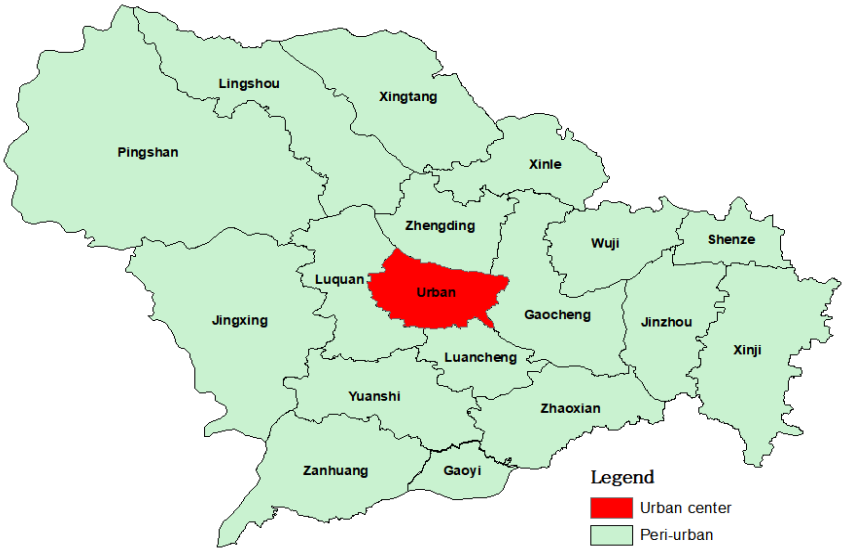

Figure 4 Distinction between urban center and peri-urban

Data source:

Data used in this model was divided into two categories: first, activity information for each urban area such as population, number of animals, plant production, livestock production, land use, fertilizer use, all obtained from province statistical year books and national data centers. Second, parameters for quantifying N fluxes such as nitrogen fixation rate, animal nitrogen excretion, nitrogen loss per livestock unit and N loss from different N input terms were collected. All parameters were obtained from literature and questionnaires. These datasets were compiled and used to calculate N fluxes in urban areas. Because the study area is Shijiazhuang in this report, all statistical data and parameters have been collected for Shijiazhuang. Details can be seen in the following descriptions of each subsystem.

N budget calculated for urban areas and 5 subsystems based on NUFER model.

Our urban area N budget was estimated based on the mass balance principle which includes all inputs and outputs for the whole system. Input pathways considered were: biological N fixation, N deposition, synthetic fertilizer, irrigation, manure input and import of N containing products. Output pathways considered were: production of livestock, production of crop, atmospheric N emission, fluvial N losses and export of N contained in products (production of crop and livestock minus food demand). Actually, these N pathways were all calculated at the subsystem level. Specifically, the N fluxes for each pathway were calculated as a sum of N fluxes to Agricultural land, livestock, urban green, pet and horticulture. Thus, the N budgets of 5 subsystems were calculated first, then the overall N budget for the whole urban area was compiled by summing up all N fluxes. The following sections describe the N budgets of the 5 subsystems.

Agricultural land system

All inputs to agricultural land include synthetic fertilizer N, seed, BNF, deposition, irrigation, manure. Outputs from agricultural land considered included grain and straw harvested, atmospheric N emission, recycled straw and fluvial N loss to water. The calculation used for agricultural land was:

$CL_{IN} = CL_{fer}+CL_{BNF}+CL_{Dep}+CL_{Irr}+CL_{seed}+CL_{Exc}+CL_{gg}$

$Cl_{out}=CLcrop+CLloss+CL_{straw}$

Where CL_{IN} and Cl_{out} are the total N input to and output from the agricultural land system; CL_{fer} is synthetic fertilizer application; CL_{BNF} is the BNF including symbiotic and non-symbiotic N fixation; CL_{Exc} is manure N excretion recycled to agricultural land from livestock and humans; CL_{Dep} is N deposition including both dry and wet deposition; CL_{Irr} is irrigation; CL_{seed} is N input from seed; CL_{gg} is the N input from green fodder, grass to agricultural land. CL_{crop} is crop production; CL_{loss} is the N loss to atmosphere and hydrosphere; CL_{straw} is the staw recycled to agricultural land.

Livestock system:

Livestock was split into 7 categories: pig, milk cow, meat cow, poultry, horse, rabbit, mule and donkey, sheep and goat. To quantify N fluxes contained in forage, forage was divided into forage produced in domestic areas and imported from other areas. We considered inputs to animal feeding including crop produced within domestic area and imported forage, and outputs were animal product output and excretion. Parts of animal excretion were recycled to agricultural land as manure. The equation used for the calculation is:

$LS_{IN}=LS_{crop}+LS_{imported}$

$LS_{OUT}=LS_{product}+LS_{manure}+LS_{loss}$

Where LS_{IN} and LS_{OUT} are the total N inputs to and outputs from the livestock system; LS_{crop} is crops used as livestock feed produced from domestic production; $LS_{imported}$ is imported feed. $LS_{product}$ is livestock products which are transferred to the humans system, the pet system or exported; LS_{loss} is the livestock excretion lost to the atmosphere or hydrosphere, which is livestock excretion multiply by ratio of livestock manure to atmosphere or hydrosphere.

Urban green system

The boundary of urban green system includes both, urban lawn (including park and university lawn) and forest (including shrub). The urban green land has similar N cycling as agricultural land, where synthetic fertilizer is the major N input. Livestock manure was not returned to urban green areas, but part of pet manure was returned to urban green areas. Other N inputs include BNF, N deposition and irrigation. The green waste (evergreen lawns, shrub clipping litter) was the most important N output. Other N outputs mainly included N loss to air and N loss to water. The equation used for the calculation is:

$$UG_{IN}=UG_{fer}+UG_{Dep}+UG_{Irr}+UG_{BNF}+UG_{Exc}$$

$$UG_{OUT}=UG_{waste}+UG_{loss}$$

Where UG_{IN} and UG_{out} are the total N input to and output from urban green system; UG_{fer} is synthetic fertilizer application; UG_{BNF} is the BNF including symbiotic and non-symbiotic N fixation; UG_{Exc} is excretion recycled to urban green from livestock and pet; UG_{Dep} is N deposition including both dry and wet deposition; UG_{Irr} is irrigation. UG_{waste} is lawns and shrub to waste; UG_{loss} is the N loss to atmosphere and hydrosphere.

Pet system

Due to the availability of horse numbers in general, but limited availability of pet horse numbers in the urban areas, the N fluxes related to horses was accounted for in the livestock subsystem. The

present study only considers domestic dogs, domestic cats, homeless dogs and homeless cats. The pet subsystem only consumes food products but does not produce any goods that are then exported to other subsystems (except parts of manure returned to urban green). The N input and output for the pet system used were:

$PT_{IN}= PT_{feed} +PT_{kit}+PT_{imported}$

$PTOUT=PT_{manure}+PT_{waste}$

Where PT_{IN} and PT_{out} are the total N input to and output from the pet system; PT_{feed} is pet (including dogs and cats) feed input produced from domestic production; PT_{waste} is imported feed. PT_{manure} is the manure recycled to urban green; PT_{waste} is the manure to waste.

Horticulture:

The horticulture definition in this model only consider the flower, ornamental tree and lawns production for profit. The horticulture is constituted of different types of cultivating plants production, which are mainly used for the decoration of the city on important holidays. Because the vegetable production in China is considered as larger scale, the model consider vegetable production under agricultural land system.

Horticulture for profit is more common in south China, but less common elsewhere in China. The present study focuses on north China. Therefore, the major N input in horticulture was the import of N contained in flowers. Other N inputs include irrigation, deposition and nutrition soil produced in domestic areas. Outputs include decoration flowers going to households or waste, N loss to air and export of N contained in flowers. The equation used for the calculation is:

$HC_{IN}=HC_{Irr}+HC_{Dep}+HC_{imported}+HC_{soil}$

$HC_{OUT}=HC_{waste}+HC_{loss}$

Where HC_{IN} and HC_{out} are the total N input to and output from horticulture system; HC_{Dep} is N deposition including both dry and wet deposition; HC_{Irr} is irrigation; HCimported is imported flower from outside; HC_{soil} is nutrition soil. HC_{waste} is the flower to waste; HC_{loss} is the N loss to atmosphere and hydrosphere.

Result:

The Nitrogen budget including 5 subsystems within the urban center of Shijiazhuang is described in figure 5. N input that cascades among the 5 subsystems through interaction, were indicated by being the N output from one subsystem and the N input to another systems. All N input will eventually become N output of Shijiazhuang or accumulate within Shijiazhuang after cycling through multiple subsystems. Agricultural land was the subsystem with the highest N input. The most important input from outside the agricultural land systems was synthetic fertilizer N (11920 tonnes N/yr). Agricultural land N products were an important output, also including harvested product used as feed for livestock system (4000 tonnes N/yr). However, harvested product used as pet food was only about 1 tonnes N/yr. For the harvested straw, about 800 tonnes N/yr, that was recycled to soil, the remainder N was either lost to the atmosphere or hydrosphere.

Total N input to livestock system was mainly coming from agricultural land systems and imported feed (2700 tonnes N/yr). Total production of livestock system is 4300 tonnes /yr, with only 70 tonnes N/yr used as feed for the pet system. Only 1200 tonnes N/yr were used as manure for agricultural land system.

The N inputs to the grassland system include synthetic fertilizer (1000 tonnes N/yr), biological nitrogen fixation (200 tonnes N/yr) and pet manure (40 tonnes N/yr). The major outputs from urban green were losses to the atmosphere (300 tonnes N/yr) and waste (100 tonnes N/yr). There was no N output from the urban green system to any other system.

The horticulture subsystem was mainly composed of imported flowers (220 tonnes N/yr) and irrigation (2 tonnes N/yr). Horticulture was similar to urban green, with most of N lost to waste and the atmosphere.

N input to the pet system mainly came from other subsystem, such as the livestock system (70 tonnes N/yr) and agricultural land (63 tonnes N/yr). Only the manure disposed by pets transferred to urban green (40 tonnes N/yr) and the remainder N was lost to the hydrosphere and the atmosphere.

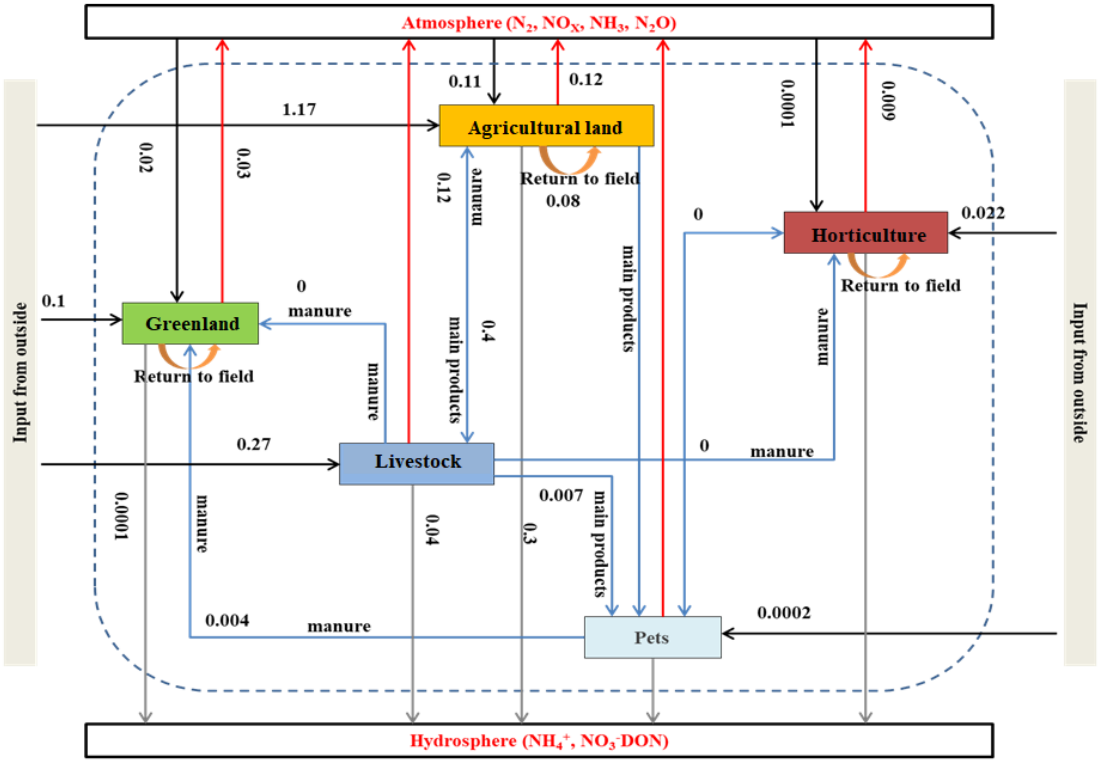

Figure 5 Nitrogen budgets among five subsystems in Shijiazhuang

The N flow characteristic in the peri-urban part of Shijiazhuang is described in Figure 6. In common with urban center, agricultural land still was the subsystem with the highest N input. Because N input in agricultural land was related to land use, N input varies widely by cropland (including grassland used for grass fodder production). The N input in the peri-urban area is larger than in the urban center due to large area of cropland. Also livestock farming is concentrated in Shijiazhuang's peri-urban area, hence the total N input of livestock system in peri-urban areas is

larger than in the urban center. The N flow results of remaining subsystems in peri-urban are similar to urban areas.

Regarding to future plan, we are planning to carry out extended NUFER model and one core distinction for the other three test areas in the project (Beijing, Vienna, Zielona Góra). The N flow characteristics in Shijiazhuang will be compared with the other cities, and the center vs.peri-urban for each city will be constructed.

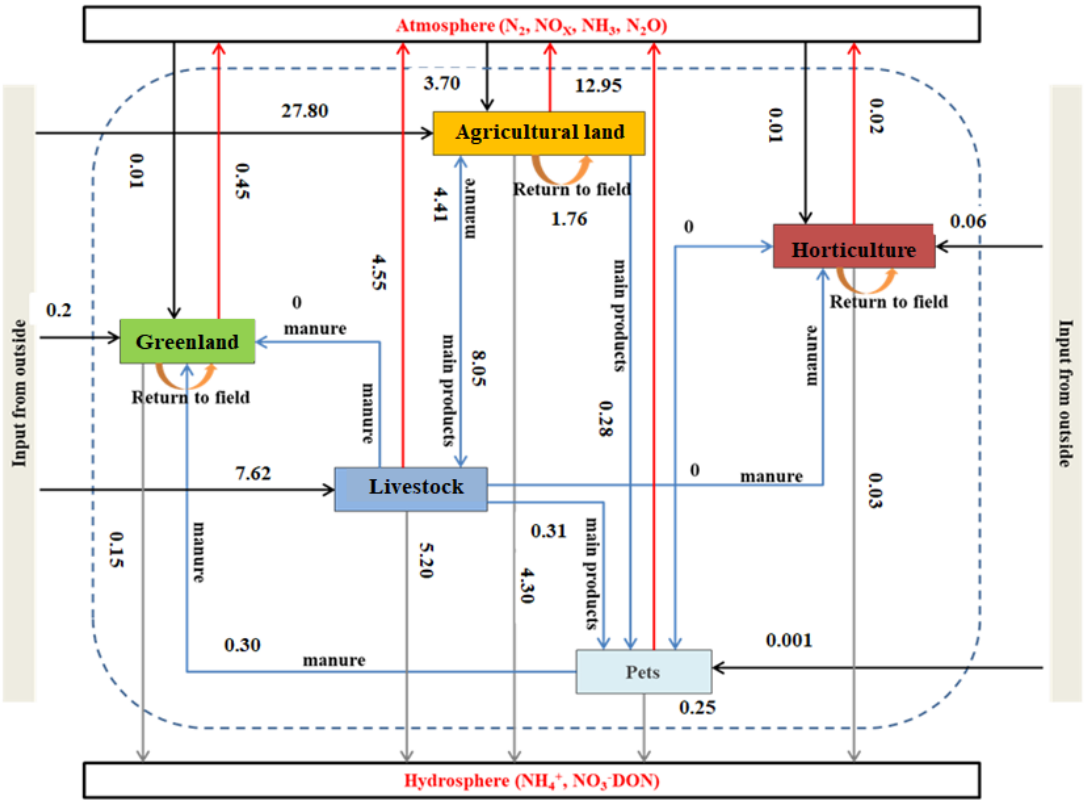

Figure 6 Nitrogen budgets among five subsystems in the peri-urban area of Shijiazhuang

Annex 2

Parameter list for urban agricultural flows

Activity data:

system	item	type	unit
plant production	amount of fertilizer consumption in cropland	single fertilizer	10000 ton
	amount of fertilizer consumption in cropland	compound fertilizer	10000 ton
	cultivated area in cropland	cultivated area	K ha
	sown area	beans	K ha
	sown area	peanut	K ha
	sown area	crop green manure	K ha
	sown area	non-beans	K ha
	sown area	rice	K ha
	sown area	wheat	K ha
	sown area	maize	K ha
	sown area	millet	K ha
	sown area	sorghum	K ha
	sown area	other cereal	K ha
	sown area	potato	K ha
	sown area	rape seed	K ha
	sown area	cotton	K ha
	sown area	flax	K ha
	sown area	sugar cane	K ha
	sown area	sugar beet	K ha
	sown area	tobacco	K ha
	sown area	vegetable	K ha
	sown area	fruit tree	K ha
	amount of crop economical organ	rice	10000 ton
	amount of crop economical organ	wheat	10000 ton
	amount of crop economical organ	maize	10000 ton
	amount of crop economical organ	millet	10000 ton

plant production	amount of crop economical organ	sorghum	10000 ton
	amount of crop economical organ	other cereal	10000 ton
	amount of crop economical organ	beans	10000 ton
	amount of crop economical organ	potato	10000 ton
	amount of crop economical organ	peanut	10000 ton
	amount of crop economical organ	rape seed	10000 ton
	amount of crop economical organ	cotton	10000 ton
	amount of crop economical organ	flax	10000 ton
	amount of crop economical organ	sugar cane	10000 ton
	amount of crop economical organ	sugar beet	10000 ton
	amount of crop economical organ	tobacco	10000 ton
	amount of crop economical organ	vegetable	10000 ton
	amount of crop economical organ	fruit tree	10000 ton
	sown area	green fodder	K ha
	sown area	managed grass	K ha
	sown area	natural grass	K ha
	sown area	green fodder	K ha
	plant food export	rice	10000 ton
	plant food export	wheat	10000 ton
	plant food export	maize	10000 ton
	plant food export	millet	10000 ton
	plant food export	sorghum	10000 ton
	plant food export	other cereal	10000 ton
	plant food export	beans	10000 ton
	plant food export	potato	10000 ton
	plant food export	peanut	10000 ton
	plant food export	rape seed	10000 ton
	plant food export	cotton	10000 ton
	plant food export	flax	10000 ton
	plant food export	sugar cane	10000 ton
	plant food export	sugar beet	10000 ton
	plant food export	tobacco	10000 ton

plant production	plant food export	vegetable	10000 ton
	plant food export	fruit tree	10000 ton
	plant food import	rice	10000 ton
	plant food import	wheat	10000 ton
	plant food import	maize	10000 ton
	plant food import	millet	10000 ton
	plant food import	sorghum	10000 ton
	plant food import	other cereal	10000 ton
	plant food import	beans	10000 ton
	plant food import	potato	10000 ton
	plant food import	peanut	10000 ton
	plant food import	rape seed	10000 ton
	plant food import	cotton	10000 ton
	plant food import	flax	10000 ton
	plant food import	sugar cane	10000 ton
	plant food import	sugar beet	10000 ton
	plant food import	tobacco	10000 ton
	plant food import	vegetable	10000 ton
	plant food import	fruit tree	10000 ton
	total area of cropland	cropland	K ha
animal production	yield	natural fishery	10000 ton
	yield	management fishery	10000 ton
	yield	egg	10000 ton
	yield	milk	10000 ton
	rate of intensive breeding	egg Layer（>500 capita）	%
	rate of intensive breeding	meat chicken（>2000 capita）	%
	rate of intensive breeding	milk cow（>5 capita）	%
	rate of intensive breeding	meat cow（>50 capita）	%
	rate of intensive breeding	pig（>50 capita）	%
	the rate of animal in grazing	pig（1-50 capita）	%
	the rate of animal in grazing	pig（>50 capita）	%

animal production	the rate of animal in grazing	milk cow（1-5 capita）	%
	the rate of animal in grazing	milk cow（>5 capita）	%
	the rate of animal in grazing	meat cow（1-50 capita）	%
	the rate of animal in grazing	meat cow（>50 capita）	%
	the rate of animal in grazing	other cow（buffalo and yellow）	%
	the rate of animal in grazing	poultry breed with traditional household	%
	the rate of animal in grazing	meat cow（>50 capita）	%
	the rate of animal in grazing	meat cow（1-50 capita）	%
	the rate of animal in grazing	poultry breed with traditional household	%
	the rate of animal in grazing	egg Layer（>500 capita）	%
	the rate of animal in grazing	meat chicken（>2000 capita）	%
	the rate of animal in grazing	sheep and goat	%
	the rate of animal in grazing	horse	%
	the rate of animal in grazing	mule and donkey	%
	the rate of animal in grazing	rabbit	%
	the ratio of animal manure to natural grassland	pig（1-50 capita）	%
	the ratio of animal manure to natural grassland	pig（>50 capita）	%
	the ratio of animal manure to natural grassland	milk cow（1-5 capita）	%
	the ratio of animal manure to natural grassland	milk cow（>5 capita）	%
	the ratio of animal manure to natural grassland	meat cow（1-50 capita）	%
	the ratio of animal manure to natural grassland	meat cow（>50 capita）	%
	the ratio of animal manure to natural grassland	other cow（buffalo and yellow）	%
	the ratio of animal manure to natural grassland	poultry breed with traditional household	%
	the ratio of animal manure to natural grassland	meat cow（>50 capita）	%
	the ratio of animal manure to natural grassland	meat cow（1-50 capita）	%
	the ratio of animal manure to natural grassland	poultry breed with traditional household	%
	the ratio of animal manure to natural grassland	egg Layer（>500 capita）	%
	the ratio of animal manure to natural grassland	meat chicken（>2000 capita）	%
	the ratio of animal manure to natural grassland	sheep and goat	%
	the ratio of animal manure to natural grassland	horse	%

animal production	the ratio of animal manure to natural grassland	mule and donkey	%
	number of animal	pig（1-50 capita）	10000 head
	number of animal	pig（>50 capita）	10000 head
	number of animal	milk cow（1-5 capita）	10000 head
	number of animal	milk cow（>5 capita）	10000 head
	number of animal	meat cow（1-50 capita）	10000 head
	number of animal	meat cow（>50 capita）	10000 head
	number of animal	other cow（buffalo and yellow）	10000 head
	number of animal	poultry breed with traditional household	10000 head
	number of animal	egg Layer（>500 capita）	10000 head
	number of animal	meat chicken（>2000 capita）	10000 head
	number of animal	sheep and goat	10000 head
	number of animal	horse	10000 head
	number of animal	mule and donkey	10000 head
	number of animal	rabbit	10000 head
	animal food import	pig	10000 ton
	animal food import	meat cow	10000 ton
	animal food import	poultry	10000 ton
	animal food import	sheep and goat	10000 ton
	animal food import	rabbit	10000 ton
	animal food import	egg	10000 ton
	animal food import	milk	10000 ton
	animal food import	fishery	10000 ton
	animal food export	pig	10000 ton
	animal food export	meat cow	10000 ton
	animal food export	poultry	10000 ton
	animal food export	sheep and goat	10000 ton
	animal food export	rabbit	10000 ton
	animal food export	egg	10000 ton
	animal food export	milk	10000 ton
	animal food export	fishery	10000 ton

human consumption	number of population	urban	10000
	amount of plant food consumption per person annual in urban	rice	kg/per/a
	amount of plant food consumption per person annual in urban	wheat	kg/per/a
	amount of plant food consumption per person annual in urban	maize	kg/per/a
	amount of plant food consumption per person annual in urban	millet	kg/per/a
	amount of plant food consumption per person annual in urban	sorghum	kg/per/a
	amount of plant food consumption per person annual in urban	other cereal	kg/per/a
	amount of plant food consumption per person annual in urban	beans	kg/per/a
	amount of plant food consumption per person annual in urban	potato	kg/per/a
	amount of plant food consumption per person annual in urban	peanut	kg/per/a
	amount of plant food consumption per person annual in urban	rape seed	kg/per/a
	amount of plant food consumption per person annual in urban	cotton	kg/per/a
	amount of plant food consumption per person annual in urban	flax	kg/per/a
	amount of plant food consumption per person annual in urban	sugar cane	kg/per/a
	amount of plant food consumption per person annual in urban	sugar beet	kg/per/a
	amount of plant food consumption per person annual in urban	tobacco	kg/per/a
	amount of plant food consumption per person annual in urban	vegetable	kg/per/a
	amount of plant food consumption per person annual in urban	fruit tree	kg/per/a
	amount of animal food consumption per person annual in urban	pig	kg/per/a
	amount of animal food consumption per person annual in urban	cow	kg/per/a
	amount of animal food consumption per person annual in urban	poultry	kg/per/a
	amount of animal food consumption per person annual in urban	sheep and goat	kg/per/a
	amount of animal food consumption per person annual in urban	rabbit	kg/per/a
	amount of animal food consumption per person annual in urban	egg	kg/per/a
	amount of animal food consumption per person annual in urban	milk	kg/per/a
	amount of animal food consumption per person annual in urban	fishery	kg/per/a
	rural population	rural	10000 head
	house size	rural and urban	unitless
	livestock consumption	human consumption	10000ton
	crop consumption	human consumption	10000ton
urban green	amount of fertilizer consumption in urban green	single fertilizer	10000 ton
	amount of fertilizer consumption in urban green	compound fertilizer	10000 ton

urban green	urban green area	non-beans	K ha
	yield of fallen leaves	urban green	10000 ton
	yield of fallen tree limb	urban green	10000 ton
	lawns	urban green	ha
	evergreen	urban green	ha
	shrub	urban green	ha
pet system	imported feed	cat	10000 ton
	imported feed	dog	10000 ton
	imported feed	horse	10000 ton
	imported feed	pig	10000 ton
	imported feed	meat cow	10000 ton
	imported feed	poultry	10000 ton
	imported feed	sheep and goat	10000 ton
	imported feed	rabbit	10000 ton
	number of pet	cat	10000 head
	number of pet	dog	10000 head
	number of pet	horse	10000 head
	dog keep-percentage	pet	%
	averaged N intake by dog	pet	g N/kg/d
	average dog weight	pet	kg
	food production within area	pet	kg
	cat keep-percentage	pet	%
	averaged N intake by cat	pet	g N/kg/d
	average cat weight	pet	kg
	food production within area	pet	10000ton
horticulture	amount of fertilizer consumption in horticultural	single fertilizer	10000 ton
	amount of fertilizer consumption in horticultural	compound fertilizer	10000 ton
	total area of horticultural	horticultural	ha
	mount of decoration flowers	horticultural	10000 ton
	flower export	horticultural	10000 ton
	amount of total horticultural	horticultural	10000ton
	amount of total nutrition soil used	horticultural	10000ton

horticulture	Nutrition soil produced in area	horticultural	%

Parameter data:

system	item	type	unit
plant production	fertilizer	nitrogen content of compound fertilizer	%
	the ratio of nitrogen fixation	beans	$kghm^{-2}a^{-1}$
	the ratio of nitrogen fixation	peanut	$kghm^{-2}a^{-1}$
	the ratio of nitrogen fixation	green manure	$kghm^{-2}a^{-1}$
	the ratio of nitrogen fixation	non-beans	$kghm^{-2}a^{-1}$
	the amount of sown nitrogen	rice	$kghm^{-2}$
	the amount of sown nitrogen	wheat	$kghm^{-2}$
	the amount of sown nitrogen	maize	$kghm^{-2}$
	the amount of sown nitrogen	millet	$kghm^{-2}$
	the amount of sown nitrogen	sorghum	$kghm^{-2}$
	the amount of sown nitrogen	other cereal	$kghm^{-2}$
	the amount of sown nitrogen	beans	$kghm^{-2}$
	the amount of sown nitrogen	potato	$kghm^{-2}$
	the amount of sown nitrogen	peanut	$kghm^{-2}$
	the amount of sown nitrogen	rape seed	$kghm^{-2}$
	the amount of sown nitrogen	cotton	$kghm^{-2}$
	the amount of sown nitrogen	flax	$kghm^{-2}$
	the amount of sown nitrogen	sugar cane	$kghm^{-2}$
	the amount of sown nitrogen	sugar beet	$kghm^{-2}$
	the amount of sown nitrogen	tobacco	$kghm^{-2}$
	the amount of sown nitrogen	vegetable	$kghm^{-2}$

plant production	the amount of sown nitrogen	fruit tree	$kghm^{-2}$
	nitrogen content of crop economical organ	rice	%
	nitrogen content of crop economical organ	wheat	%
	nitrogen content of crop economical organ	maize	%
	nitrogen content of crop economical organ	millet	%
	nitrogen content of crop economical organ	sorghum	%
	nitrogen content of crop economical organ	other cereal	%
	nitrogen content of crop economical organ	beans	%
	nitrogen content of crop economical organ	potato	%
	nitrogen content of crop economical organ	peanut	%
	nitrogen content of crop economical organ	rape seed	%
	nitrogen content of crop economical organ	cotton	%
	nitrogen content of crop economical organ	flax	%
	nitrogen content of crop economical organ	sugar cane	%
	nitrogen content of crop economical organ	sugar beet	%
	nitrogen content of crop economical organ	tobacco	%
	nitrogen content of crop economical organ	vegetable	%
	nitrogen content of crop economical organ	fruit tree	%
	the yield per unit area	green fodder	t/hm^2
	the yield per unit area	managed grass	t/hm^2
	the yield per unit area	natural grass	t/hm^2
	nitrogen content of crop economical organ	green manure	%
	nitrogen content of crop economical organ	green fodder	%
	nitrogen content of crop economical organ	grass	%
	The ratio of straw to yield	rice	%
	The ratio of straw to yield	wheat	%
	The ratio of straw to yield	maize	%
	The ratio of straw to yield	millet	%

plant production	The ratio of straw to yield	sorghum	%
	The ratio of straw to yield	other cereal	%
	The ratio of straw to yield	beans	%
	The ratio of straw to yield	potato	%
	The ratio of straw to yield	peanut	%
	The ratio of straw to yield	rape seed	%
	The ratio of straw to yield	cotton	%
	The ratio of straw to yield	flax	%
	The ratio of straw to yield	sugar cane	%
	The ratio of straw to yield	sugar beet	%
	The ratio of straw to yield	tobacco	%
	The ratio of straw to yield	vegetable	%
	The ratio of straw to yield	fruit tree	%
	nitrogen content of straw	rice	%
	nitrogen content of straw	wheat	%
	nitrogen content of straw	maize	%
	nitrogen content of straw	millet	%
	nitrogen content of straw	sorghum	%
	nitrogen content of straw	other cereal	%
	nitrogen content of straw	beans	%
	nitrogen content of straw	potato	%
	nitrogen content of straw	peanut	%
	nitrogen content of straw	rape seed	%
	nitrogen content of straw	cotton	%
	nitrogen content of straw	flax	%
	nitrogen content of straw	sugar cane	%
	nitrogen content of straw	sugar beet	%
	nitrogen content of straw	tobacco	%

plant production	nitrogen content of straw	vegetable	%
	nitrogen content of straw	fruit tree	%
	the ratio of cultivated land area to country area	the ratio of cultivated land area to country area	%
	the ratio of green fodder to field	green fodder	%
	the ratio of managed grass to field	managed grass	%
	the ratio of natural grass to feed	natural grass	%
	the ratio of straw to field	rice	%
	the ratio of straw to field	wheat	%
	the ratio of straw to field	maize	%
	the ratio of straw to field	millet	%
	the ratio of straw to field	sorghum	%
	the ratio of straw to field	other cereal	%
	the ratio of straw to field	beans	%
	the ratio of straw to field	potato	%
	the ratio of straw to field	peanut	%
	the ratio of straw to field	rape seed	%
	the ratio of straw to field	cotton	%
	the ratio of straw to field	flax	%
	the ratio of straw to field	sugar cane	%
	the ratio of straw to field	sugar beet	%
	the ratio of straw to field	tobacco	%
	the ratio of straw to field	vegetable	%
	the ratio of straw to field	fruit tree	%
	the ratio of crop economical organ to feed	rice	%
	the ratio of crop economical organ to feed	wheat	%
	the ratio of crop economical organ to feed	maize	%
	the ratio of crop economical organ to feed	millet	%
	the ratio of crop economical organ to feed	sorghum	%

plant production	the ratio of crop economical organ to feed	other cereal	%
	the ratio of crop economical organ to feed	beans	%
	the ratio of crop economical organ to feed	potato	%
	the ratio of crop economical organ to feed	peanut	%
	the ratio of crop economical organ to feed	rape seed	%
	the ratio of crop economical organ to feed	cotton	%
	the ratio of crop economical organ to feed	flax	%
	the ratio of crop economical organ to feed	sugar cane	%
	the ratio of crop economical organ to feed	sugar beet	%
	the ratio of crop economical organ to feed	tobacco	%
	the ratio of crop economical organ to feed	vegetable	%
	the ratio of crop economical organ to feed	fruit tree	%
	the ratio of straw to feed	rice	%
	the ratio of straw to feed	wheat	%
	the ratio of straw to feed	maize	%
	the ratio of straw to feed	millet	%
	the ratio of straw to feed	sorghum	%
	the ratio of straw to feed	other cereal	%
	the ratio of straw to feed	beans	%
	the ratio of straw to feed	potato	%
	the ratio of straw to feed	peanut	%
	the ratio of straw to feed	rape seed	%
	the ratio of straw to feed	cotton	%
	the ratio of straw to feed	flax	%
	the ratio of straw to feed	sugar cane	%
	the ratio of straw to feed	sugar beet	%
	the ratio of straw to feed	tobacco	%
	the ratio of straw to feed	vegetable	%

plant production	the ratio of straw to feed	fruit tree	%
	the ratio of managed grass to feed	managed grass	%
	the ratio of natural grass to feed	natural grass	%
	ratio of deposition	ratio of deposition	kg/ha
	nitrogen content of wet deposition	nitrogen content of wet deposition	$kghm^{-2}a^{-1}$
	nitrogen content of irrigation water	nitrogen content of irrigation water	$kghm^{-2}a^{-1}$
	the ratio of runoff loss	the ratio of runoff loss	%
	EFerosion max maximum coefficient of soil erosion	plant production	unitless
	fp effective precipitation reduction factor	plant production	unitless
	flu vegetation reduction factor	plant production	unitless
	frc plough depth reduction factor	plant production	unitless
	fs soil texture	plant production	unitless
	SRFmax coefficient of maximum surface runoff	plant production	unitless
	LF soil texture max coefficient of maximum leaching	plant production	unitless
	fr root depth reduction factor	plant production	unitless
	ft average temperature reduction factor	plant production	unitless
	fc soil organic matter content	plant production	unitless
	the ratio of chemical fertilizer NH_3	the ratio of chemical fertilizer NH_3	%
	the ratio of chemical fertilizer N_2O	the ratio of chemical fertilizer N_2O	%
	the ratio of straw return to field N_2O emission	rice	%
	the ratio of straw return to field N_2O emission	wheat	%
	the ratio of straw return to field N_2O emission	maize	%
	the ratio of straw return to field N_2O emission	millet	%
	the ratio of straw return to field N_2O emission	sorghum	%
	the ratio of straw return to field N_2O emission	other cereal	%
	the ratio of straw return to field N_2O emission	beans	%
	the ratio of straw return to field N_2O emission	potato	%
	the ratio of straw return to field N_2O emission	peanut	%

plant production	the ratio of straw return to field N_2O emission	rape seed	%
	the ratio of straw return to field N_2O emission	cotton	%
	the ratio of straw return to field N_2O emission	flax	%
	the ratio of straw return to field N_2O emission	sugar cane	%
	the ratio of straw return to field N_2O emission	sugar beet	%
	the ratio of straw return to field N_2O emission	tobacco	%
	the ratio of straw return to field N_2O emission	vegetable	%
	the ratio of straw return to field N_2O emission	fruit tree	%
	the ratio of green fodder to field N_2O emission	green fodder	%
	the ratio of grass to field N_2O emission	managed grass	%
	the ratio of grass to field N_2O emission	natural grass	%
	the factor of animal manure N_2O emission in the field	pig（1-50 capita）	%
	the factor of animal manure N_2O emission in the field	pig（>50 capita）	%
	the factor of animal manure N_2O emission in the field	milk cow（1-5 capita）	%
	the factor of animal manure N_2O emission in the field	milk cow（>5 capita）	%
	the factor of animal manure N_2O emission in the field	meat cow（1-50 capita）	%
	the factor of animal manure N_2O emission in the field	meat cow（>50 capita）	%
	the factor of animal manure N_2O emission in the field	other cow（buffalo and yellow）	%
	the factor of animal manure N_2O emission in the field	poultry breed with traditional household	%
	the factor of animal manure N_2O emission in the field	egg Layer（>500 capita）	%
	the factor of animal manure N_2O emission in the field	meat chicken（>2000 capita）	%
	the factor of animal manure N_2O emission in the field	sheep and goat	%
	the factor of animal manure N_2O emission in the field	horse	%
	the factor of animal manure N_2O emission in the field	Mule and donkey	%
	the factor of animal manure N_2O emission in the field	rabbit	%
	the factor of human manure N_2O emission in the field	rural	%
	the factor of human manure N_2O emission in the field	urban	%
	coefficient of denitrification	chemical fertilizer	unitless

animal production	amount of animal nitrogen excretion	pig（1-50 capita）	kg/unit/a
	amount of animal nitrogen excretion	pig（>50 capita）	kg/unit/a
	amount of animal nitrogen excretion	milk cow（1-5 capita）	kg/unit/a
	amount of animal nitrogen excretion	milk cow（>5 capita）	kg/unit/a
	amount of animal nitrogen excretion	meat cow（1-50 capita）	kg/unit/a
	amount of animal nitrogen excretion	meat cow（>50 capita）	kg/unit/a
	amount of animal nitrogen excretion	other cow（buffalo and yellow）	kg/unit/a
	amount of animal nitrogen excretion	poultry breed with traditional household	kg/unit/a
	amount of animal nitrogen excretion	egg Layer（>500 capita）	kg/unit/a
	amount of animal nitrogen excretion	meat chicken（>2000 capita）	kg/unit/a
	amount of animal nitrogen excretion	sheep and goat	kg/unit/a
	amount of animal nitrogen excretion	horse	kg/unit/a
	amount of animal nitrogen excretion	Mule and donkey	kg/unit/a
	amount of animal nitrogen excretion	rabbit	kg/unit/a
	nitrogen content of edible part	pig	%
	nitrogen content of edible part	meat cow	%
	nitrogen content of edible part	poultry	%
	nitrogen content of edible part	sheep and goat	%
	nitrogen content of edible part	rabbit	%
	nitrogen content of animal product	egg	%
	nitrogen content of animal product	milk	%
	nitrogen content of animal product	fishery	%
	Animal weight	pig	kg
	Animal weight	meat cow	kg
	Animal weight	poultry	kg
	Animal weight	sheep and goat	kg
	Animal weight	rabbit	kg
	the ratio of bone	pig	%

animal production	the ratio of bone	meat cow	%
	the ratio of bone	poultry	%
	the ratio of bone	sheep and goat	%
	the ratio of bone	rabbit	%
	nitrogen content of bone	pig	%
	nitrogen content of bone	meat cow	%
	nitrogen content of bone	poultry	%
	nitrogen content of bone	sheep and goat	%
	nitrogen content of bone	rabbit	%
	the ratio of by-product	pig	%
	the ratio of by-product	meat cow	%
	the ratio of by-product	poultry	%
	the ratio of by-product	sheep and goat	%
	the ratio of by-product	rabbit	%
	nitrogen content of by-product	pig	%
	nitrogen content of by-product	meat cow	%
	nitrogen content of by-product	poultry	%
	nitrogen content of by-product	sheep and goat	%
	nitrogen content of by-product	rabbit	%
	the ratio of animal manure to field	pig（1-50 capita）	%
	the ratio of animal manure to field	pig（>50 capita）	%
	the ratio of animal manure to field	milk cow（1-5 capita）	%
	the ratio of animal manure to field	milk cow（>5 capita）	%
	the ratio of animal manure to field	meat cow（1-50 capita）	%
	the ratio of animal manure to field	meat cow（>50 capita）	%
	the ratio of animal manure to field	other cow（buffalo and yellow）	%
	the ratio of animal manure to field	poultry breed with traditional household	%
	the ratio of animal manure to field	egg Layer（>500 capita）	%

animal production	the ratio of animal manure to field	meat chicken（>2000 capita）	%
	the ratio of animal manure to field	sheep and goat	%
	the ratio of animal manure to field	horse	%
	the ratio of animal manure to field	Mule and donkey	%
	the ratio of animal manure to field	rabbit	%
	the ratio of manure N_2O emission in the barn	pig（1-50 capita）	%
	the ratio of manure N_2O emission in the barn	pig（>50 capita）	%
	the ratio of manure N_2O emission in the barn	milk cow（1-5 capita）	%
	the ratio of manure N_2O emission in the barn	milk cow（>5 capita）	%
	the ratio of manure N_2O emission in the barn	meat cow（1-50 capita）	%
	the ratio of manure N_2O emission in the barn	meat cow（>50 capita）	%
	the ratio of manure N_2O emission in the barn	other cow（buffalo and yellow）	%
	the ratio of manure N_2O emission in the barn	poultry breed with traditional household	%
	the ratio of manure N_2O emission in the barn	egg Layer（>500 capita）	%
	the ratio of manure N_2O emission in the barn	meat chicken（>2000 capita）	%
	the ratio of manure N_2O emission in the barn	sheep and goat	%
	the ratio of manure N_2O emission in the barn	horse	%
	the ratio of manure N_2O emission in the barn	Mule and donkey	%
	the ratio of manure N_2O emission in the barn	rabbit	%
	the ratio of manure denitrification in the barn	pig（1-50 capita）	%
	the ratio of manure denitrification in the barn	pig（>50 capita）	%
	the ratio of manure denitrification in the barn	milk cow（1-5 capita）	%
	the ratio of manure denitrification in the barn	milk cow（>5 capita）	%
	the ratio of manure denitrification in the barn	meat cow（1-50 capita）	%
	the ratio of manure denitrification in the barn	meat cow（>50 capita）	%
	the ratio of manure denitrification in the barn	other cow（buffalo and yellow）	%
	the ratio of manure denitrification in the barn	poultry breed with traditional household	%
	the ratio of manure denitrification in the barn	egg Layer（>500 capita）	%

animal production	the ratio of manure denitrification in the barn	meat chicken（>2000 capita）	%
	the ratio of manure denitrification in the barn	sheep and goat	%
	the ratio of manure denitrification in the barn	horse	%
	the ratio of manure denitrification in the barn	Mule and donkey	%
	the ratio of manure denitrification in the barn	rabbit	%
	the ratio of animal bone	the ratio of animal bone to feed	%
	the ratio of animal by-production	the ratio of animal by-production to feed	%
	the factor of animal manure NH_3 emission in the field	pig（1-50 capita）	%
	the factor of animal manure NH_3 emission in the field	pig（>50 capita）	%
	the factor of animal manure NH_3 emission in the field	milk cow（1-5 capita）	%
	the factor of animal manure NH_3 emission in the field	milk cow（>5 capita）	%
	the factor of animal manure NH_3 emission in the field	meat cow（1-50 capita）	%
	the factor of animal manure NH_3 emission in the field	meat cow（>50 capita）	%
	the factor of animal manure NH_3 emission in the field	other cow（buffalo and yellow）	%
	the factor of animal manure NH_3 emission in the field	poultry breed with traditional household	%
	the factor of animal manure NH_3 emission in the field	egg Layer（>500 capita）	%
	the factor of animal manure NH_3 emission in the field	meat chicken（>2000 capita）	%
	the factor of animal manure NH_3 emission in the field	sheep and goat	%
	the factor of animal manure NH_3 emission in the field	horse	%
	the factor of animal manure NH_3 emission in the field	Mule and donkey	%
	the factor of animal manure NH_3 emission in the field	rabbit	%
	coefficient of denitrification	animal manure	unitless
	the ratio of manure NH_3 emission in the barn	pig（1-50 capita）	%
	the ratio of manure NH_3 emission in the barn	pig（>50 capita）	%
	the ratio of manure NH_3 emission in the barn	milk cow（1-5 capita）	%
	the ratio of manure NH_3 emission in the barn	milk cow（>5 capita）	%
	the ratio of manure NH_3 emission in the barn	meat cow（1-50 capita）	%
	the ratio of manure NH_3 emission in the barn	meat cow（>50 capita）	%

animal production	the ratio of manure NH_3 emission in the barn	other cow（buffalo and yellow）	%
	the ratio of manure NH_3 emission in the barn	poultry breed with traditional household	%
	the ratio of manure NH_3 emission in the barn	egg Layer（>500 capita）	%
	the ratio of manure NH_3 emission in the barn	meat chicken（>2000 capita）	%
	the ratio of manure NH_3 emission in the barn	sheep and goat	%
	the ratio of manure NH_3 emission in the barn	horse	%
	the ratio of manure NH_3 emission in the barn	Mule and donkey	%
	the ratio of manure NH_3 emission in the barn	rabbit	%
	nitrogen content of feed	pig	%
	nitrogen content of feed	meat cow	%
	nitrogen content of feed	poultry	%
	nitrogen content of feed	sheep and goat	%
	nitrogen content of feed	rabbit	%
human consumption	the ratio of food to excretion	urban	%
	nitrogen content of plant food	rice	%
	nitrogen content of plant food	wheat	%
	nitrogen content of plant food	maize	%
	nitrogen content of plant food	millet	%
	nitrogen content of plant food	sorghum	%
	nitrogen content of plant food	other cereal	%
	nitrogen content of plant food	beans	%
	nitrogen content of plant food	potato	%
	nitrogen content of plant food	peanut	%
	nitrogen content of plant food	rape seed	%
	nitrogen content of plant food	cotton	%
	nitrogen content of plant food	flax	%
	nitrogen content of plant food	sugar cane	%
	nitrogen content of plant food	sugar beet	%

human consumption	nitrogen content of plant food	tobacco	%
	nitrogen content of plant food	vegetable	%
	nitrogen content of plant food	fruit tree	%
	the ratio of crop economical organ to food	rice	%
	the ratio of crop economical organ to food	wheat	%
	the ratio of crop economical organ to food	maize	%
	the ratio of crop economical organ to food	millet	%
	the ratio of crop economical organ to food	sorghum	%
	the ratio of crop economical organ to food	other cereal	%
	the ratio of crop economical organ to food	beans	%
	the ratio of crop economical organ to food	potato	%
	the ratio of crop economical organ to food	peanut	%
	the ratio of crop economical organ to food	rape seed	%
	the ratio of crop economical organ to food	cotton	%
	the ratio of crop economical organ to food	flax	%
	the ratio of crop economical organ to food	sugar cane	%
	the ratio of crop economical organ to food	sugar beet	%
	the ratio of crop economical organ to food	tobacco	%
	the ratio of crop economical organ to food	vegetable	%
	the ratio of crop economical organ to food	fruit tree	%
	the ratio of human manure to field	urban	%
	the ratio of plant food buy or eat out of home in urban	rice	%
	the ratio of plant food buy or eat out of home in urban	wheat	%
	the ratio of plant food buy or eat out of home in urban	maize	%
	the ratio of plant food buy or eat out of home in urban	millet	%
	the ratio of plant food buy or eat out of home in urban	sorghum	%
	the ratio of plant food buy or eat out of home in urban	other cereal	%
	the ratio of plant food buy or eat out of home in urban	beans	%

human consumption	the ratio of plant food buy or eat out of home in urban	potato	%
	the ratio of plant food buy or eat out of home in urban	peanut	%
	the ratio of plant food buy or eat out of home in urban	rape seed	%
	the ratio of plant food buy or eat out of home in urban	cotton	%
	the ratio of plant food buy or eat out of home in urban	flax	%
	the ratio of plant food buy or eat out of home in urban	sugar cane	%
	the ratio of plant food buy or eat out of home in urban	sugar beet	%
	the ratio of plant food buy or eat out of home in urban	tobacco	%
	the ratio of plant food buy or eat out of home in urban	vegetable	%
	the ratio of plant food buy or eat out of home in urban	fruit tree	%
	the ratio of animal food buy or eat out of home in urban	pig	%
	the ratio of animal food buy or eat out of home in urban	cow	%
	the ratio of animal food buy or eat out of home in urban	poultry	%
	the ratio of animal food buy or eat out of home in urban	sheep and goat	%
	the ratio of animal food buy or eat out of home in urban	rabbit	%
	the ratio of animal food buy or eat out of home in urban	egg	%
	the ratio of animal food buy or eat out of home in urban	milk	%
	the ratio of animal food buy or eat out of home in urban	fishery	%
	the ratio food eaten at home in urban	rice	%
	the ratio food eaten at home in urban	wheat	%
	the ratio food eaten at home in urban	maize	%
	the ratio food eaten at home in urban	millet	%
	the ratio food eaten at home in urban	sorghum	%
	the ratio food eaten at home in urban	other cereal	%
	the ratio food eaten at home in urban	beans	%
	the ratio food eaten at home in urban	potato	%
	the ratio food eaten at home in urban	peanut	%
	the ratio food eaten at home in urban	rape seed	%

human consumption	the ratio food eaten at home in urban	cotton	%
	the ratio food eaten at home in urban	flax	%
	the ratio food eaten at home in urban	sugar cane	%
	the ratio food eaten at home in urban	sugar beet	%
	the ratio food eaten at home in urban	tobacco	%
	the ratio food eaten at home in urban	vegetable	%
	the ratio food eaten at home in urban	fruit tree	%
	the ratio food eaten at home in urban	pig	%
	the ratio food eaten at home in urban	cow	%
	the ratio food eaten at home in urban	poultry	%
	the ratio food eaten at home in urban	sheep and goat	%
	the ratio food eaten at home in urban	rabbit	%
	the ratio food eaten at home in urban	egg	%
	the ratio food eaten at home in urban	milk	%
	the ratio food eaten at home in urban	fishery	%
	the ratio food eaten out of home in urban	rice	%
	the ratio food eaten out of home in urban	wheat	%
	the ratio food eaten out of home in urban	maize	%
	the ratio food eaten out of home in urban	millet	%
	the ratio food eaten out of home in urban	sorghum	%
	the ratio food eaten out of home in urban	other cereal	%
	the ratio food eaten out of home in urban	beans	%
	the ratio food eaten out of home in urban	potato	%
	the ratio food eaten out of home in urban	peanut	%
	the ratio food eaten out of home in urban	rape seed	%
	the ratio food eaten out of home in urban	cotton	%
	the ratio food eaten out of home in urban	flax	%
	the ratio food eaten out of home in urban	sugar cane	%

human consumption	the ratio food eaten out of home in urban	sugar beet	%
	the ratio food eaten out of home in urban	tobacco	%
	the ratio food eaten out of home in urban	vegetable	%
	the ratio food eaten out of home in urban	fruit tree	%
	the ratio food eaten out of home in urban	pig	%
	the ratio food eaten out of home in urban	cow	%
	the ratio food eaten out of home in urban	poultry	%
	the ratio food eaten out of home in urban	sheep and goat	%
	the ratio food eaten out of home in urban	rabbit	%
	the ratio food eaten out of home in urban	egg	%
	the ratio food eaten out of home in urban	milk	%
	the ratio food eaten out of home in urban	fishery	%
	the ratio kitchen residue to feed	urban	%
	the ratio food to kitchen residue at home in urban	rice	%
	the ratio food to kitchen residue at home in urban	wheat	%
	the ratio food to kitchen residue at home in urban	maize	%
	the ratio food to kitchen residue at home in urban	millet	%
	the ratio food to kitchen residue at home in urban	sorghum	%
	the ratio food to kitchen residue at home in urban	other cereal	%
	the ratio food to kitchen residue at home in urban	beans	%
	the ratio food to kitchen residue at home in urban	potato	%
	the ratio food to kitchen residue at home in urban	peanut	%
	the ratio food to kitchen residue at home in urban	rape seed	%
	the ratio food to kitchen residue at home in urban	cotton	%
	the ratio food to kitchen residue at home in urban	flax	%
	the ratio food to kitchen residue at home in urban	sugar cane	%
	the ratio food to kitchen residue at home in urban	sugar beet	%
	the ratio food to kitchen residue at home in urban	tobacco	%

human consumption	the ratio food to kitchen residue at home in urban	vegetable	%
	the ratio food to kitchen residue at home in urban	fruit tree	%
	the ratio food to kitchen residue at home in urban	pig	%
	the ratio food to kitchen residue at home in urban	cow	%
	the ratio food to kitchen residue at home in urban	poultry	%
	the ratio food to kitchen residue at home in urban	sheep and goat	%
	the ratio food to kitchen residue at home in urban	rabbit	%
	the ratio food to kitchen residue at home in urban	egg	%
	the ratio food to kitchen residue at home in urban	milk	%
	the ratio food to kitchen residue at home in urban	fishery	%
	the ratio food to kitchen residue out of home in urban	rice	%
	the ratio food to kitchen residue out of home in urban	wheat	%
	the ratio food to kitchen residue out of home in urban	maize	%
	the ratio food to kitchen residue out of home in urban	millet	%
	the ratio food to kitchen residue out of home in urban	sorghum	%
	the ratio food to kitchen residue out of home in urban	other cereal	%
	the ratio food to kitchen residue out of home in urban	beans	%
	the ratio food to kitchen residue out of home in urban	potato	%
	the ratio food to kitchen residue out of home in urban	peanut	%
	the ratio food to kitchen residue out of home in urban	rape seed	%
	the ratio food to kitchen residue out of home in urban	cotton	%
	the ratio food to kitchen residue out of home in urban	flax	%
	the ratio food to kitchen residue out of home in urban	sugar cane	%
	the ratio food to kitchen residue out of home in urban	sugar beet	%
	the ratio food to kitchen residue out of home in urban	tobacco	%
	the ratio food to kitchen residue out of home in urban	vegetable	%
	the ratio food to kitchen residue out of home in urban	fruit tree	%
	the ratio food to kitchen residue out of home in urban	pig	%

the ratio food to kitchen residue out of home in urban	cow	%
the ratio food to kitchen residue out of home in urban	poultry	%
the ratio food to kitchen residue out of home in urban	sheep and goat	%
the ratio food to kitchen residue out of home in urban	rabbit	%
the ratio food to kitchen residue out of home in urban	egg	%
the ratio food to kitchen residue out of home in urban	milk	%
the ratio food to kitchen residue out of home in urban	fishery	%
the ratio of plant food by-production return to field	rice	%
the ratio of plant food by-production return to field	wheat	%
the ratio of plant food by-production return to field	maize	%
the ratio of plant food by-production return to field	millet	%
the ratio of plant food by-production return to field	sorghum	%
the ratio of plant food by-production return to field	other cereal	%
the ratio of plant food by-production return to field	beans	%
the ratio of plant food by-production return to field	potato	%
the ratio of plant food by-production return to field	peanut	%
the ratio of plant food by-production return to field	rape seed	%
the ratio of plant food by-production return to field	cotton	%
the ratio of plant food by-production return to field	flax	%
the ratio of plant food by-production return to field	sugar cane	%
the ratio of plant food by-production return to field	sugar beet	%
the ratio of plant food by-production return to field	tobacco	%
the ratio of plant food by-production return to field	vegetable	%
the ratio of plant food by-production return to field	fruit tree	%
the ratio of plant food by-production to feed	rice	%
the ratio of plant food by-production to feed	wheat	%
the ratio of plant food by-production to feed	maize	%
the ratio of plant food by-production to feed	millet	%

human consumption	the ratio of plant food by-production to feed	sorghum	%
	the ratio of plant food by-production to feed	other cereal	%
	the ratio of plant food by-production to feed	beans	%
	the ratio of plant food by-production to feed	potato	%
	the ratio of plant food by-production to feed	peanut	%
	the ratio of plant food by-production to feed	rape seed	%
	the ratio of plant food by-production to feed	cotton	%
	the ratio of plant food by-production to feed	flax	%
	the ratio of plant food by-production to feed	sugar cane	%
	the ratio of plant food by-production to feed	sugar beet	%
	the ratio of plant food by-production to feed	tobacco	%
	the ratio of plant food by-production to feed	vegetable	%
	the ratio of plant food by-production to feed	fruit tree	%
	the factor of human manure NH_3 emission in the field	rural	%
	the factor of human manure NH_3 emission in the field	urban	%
	coefficient of denitrification	human manure	unitless
	the ratio of food eaten produced in urban	rice	%
	the ratio of food eaten produced in urban	wheat	%
	the ratio of food eaten produced in urban	maize	%
	the ratio of food eaten produced in urban	millet	%
	the ratio of food eaten produced in urban	sorghum	%
	the ratio of food eaten produced in urban	other cereal	%
	the ratio of food eaten produced in urban	beans	%
	the ratio of food eaten produced in urban	potato	%
	the ratio of food eaten produced in urban	peanut	%
	the ratio of food eaten produced in urban	rape seed	%
	the ratio of food eaten produced in urban	cotton	%
	the ratio of food eaten produced in urban	flax	%

human consumption	the ratio of food eaten produced in urban	sugar cane	%
	the ratio of food eaten produced in urban	sugar beet	%
	the ratio of food eaten produced in urban	tobacco	%
	the ratio of food eaten produced in urban	vegetable	%
	the ratio of food eaten produced in urban	fruit tree	%
	the ratio of food eaten produced in urban	pig	%
	the ratio of food eaten produced in urban	meat cow	%
	the ratio of food eaten produced in urban	poultry	%
	the ratio of food eaten produced in urban	sheep and goat	%
	the ratio of food eaten produced in urban	rabbit	%
	the ratio of food eaten produced in urban	egg	%
	the ratio of food eaten produced in urban	milk	%
	the ratio of food eaten produced in urban	fishery	%
urban green	nitrogen content of irrigation water for urban green	nitrogen content of irrigation water	$kghm^{-2}a^{-1}$
	nitrogen content of fallen leaves in urban green	urban green	%
	nitrogen content of fallen tree limb	urban green	%
	the ratio of animal manure to urban green	pig（1-50 capita）	%
	the ratio of animal manure to urban green	pig（>50 capita）	%
	the ratio of animal manure to urban green	milk cow（1-5 capita）	%
	the ratio of animal manure to urban green	milk cow（>5 capita）	%
	the ratio of animal manure to urban green	meat cow（1-50 capita）	%
	the ratio of animal manure to urban green	meat cow（>50 capita）	%
	the ratio of animal manure to urban green	other cow（buffalo and yellow）	%
	the ratio of animal manure to urban green	poultry breed with traditional household	%
	the ratio of animal manure to urban green	egg Layer（>500 capita）	%
	the ratio of animal manure to urban green	meat chicken（>2000 capita）	%
	the ratio of animal manure to urban green	sheep and goat	%
	the ratio of animal manure to urban green	horse	%

urban green	the ratio of animal manure to urban green	Mule and donkey	%
	the ratio of animal manure to urban green	rabbit	%
	the ratio of livestock manure NH_3	all animal	%
	the ratio of livestock manure N_2O	all animal	%
	erosion loss	urban green	%
	surface runoff loss	urban green	%
	leaching loss	urban green	%
	fertilizer application rate	urban green	kg N/ha
	biological nitrogen fixation rate	urban green	kg N/ha
	net Primary Productivity	lawns	t C/ha/a
	percentage of pruning	lawns	%
	carbon content	lawns	%
	nitrogen content	lawns	%
	net Primary Productivity	evergreen	t C/ha/a
	percentage of pruning	evergreen	%
	carbon content	evergreen	%
	nitrogen content	evergreen	%
	net Primary Productivity	shrub	t C/ha/a
	percentage of pruning	shrub	%
	Carbon content	shrub	%
	nitrogen content	shrub	%
	nitrogen runoff	urban green	%
	nitrogen leaching	urban green	%
	NH_3 volatilization	urban green	%
	NO (denitrification)	urban green	%
	N_2O (denitrification)	urban green	%
	N_2 (denitrification)	urban green	%
pet system	the ratio of crop economical organ to feed pet	rice	%

pet system	the ratio of crop economical organ to feed pet	wheat	%
	the ratio of crop economical organ to feed pet	maize	%
	the ratio of crop economical organ to feed pet	millet	%
	the ratio of crop economical organ to feed pet	sorghum	%
	the ratio of crop economical organ to feed pet	other cereal	%
	the ratio of crop economical organ to feed pet	beans	%
	the ratio of crop economical organ to feed pet	potato	%
	the ratio of crop economical organ to feed pet	peanut	%
	the ratio of crop economical organ to feed pet	rape seed	%
	the ratio of crop economical organ to feed pet	cotton	%
	the ratio of crop economical organ to feed pet	flax	%
	the ratio of crop economical organ to feed pet	sugar cane	%
	the ratio of crop economical organ to feed pet	sugar beet	%
	the ratio of crop economical organ to feed pet	tobacco	%
	the ratio of crop economical organ to feed pet	vegetable	%
	the ratio of crop economical organ to feed pet	fruit tree	%
	the ratio of plant food by-production to feed pet	rice	%
	the ratio of plant food by-production to feed pet	wheat	%
	the ratio of plant food by-production to feed pet	maize	%
	the ratio of plant food by-production to feed pet	millet	%
	the ratio of plant food by-production to feed pet	sorghum	%
	the ratio of plant food by-production to feed pet	other cereal	%
	the ratio of plant food by-production to feed pet	beans	%
	the ratio of plant food by-production to feed pet	potato	%
	the ratio of plant food by-production to feed pet	peanut	%
	the ratio of plant food by-production to feed pet	rape seed	%
	the ratio of plant food by-production to feed pet	cotton	%
	the ratio of plant food by-production to feed pet	flax	%

pet system	the ratio of plant food by-production to feed pet	sugar cane	%
	the ratio of plant food by-production to feed pet	sugar beet	%
	the ratio of plant food by-production to feed pet	tobacco	%
	the ratio of plant food by-production to feed pet	vegetable	%
	the ratio of plant food by-production to feed pet	fruit tree	%
	the ratio of straw to feed pet	rice	%
	the ratio of straw to feed pet	wheat	%
	the ratio of straw to feed pet	maize	%
	the ratio of straw to feed pet	millet	%
	the ratio of straw to feed pet	sorghum	%
	the ratio of straw to feed pet	other cereal	%
	the ratio of straw to feed pet	beans	%
	the ratio of straw to feed pet	potato	%
	the ratio of straw to feed pet	peanut	%
	the ratio of straw to feed pet	rape seed	%
	the ratio of straw to feed pet	cotton	%
	the ratio of straw to feed pet	flax	%
	the ratio of straw to feed pet	sugar cane	%
	the ratio of straw to feed pet	sugar beet	%
	the ratio of straw to feed pet	tobacco	%
	the ratio of straw to feed pet	vegetable	%
	the ratio of straw to feed pet	fruit tree	%
	the ratio of green fodder and grass to feed pet	manged grass	%
	the ratio of green fodder and grass to feed pet	natural grass	%
	the ratio of animal bone to feed pet	animal production	%
	the ratio of animal by-production to feed pet	animal production	%
	the ratio kitchen residue to feed pet	human consumption	%
	nitrogen content of feed	cat	%

pet system	nitrogen content of feed	dog	%
	nitrogen content of feed	horse	%
	amount of animal nitrogen excretion	cat	kg/unit/a
	amount of animal nitrogen excretion	dog	kg/unit/a
	amount of animal nitrogen excretion	horse	kg/unit/a
	the ratio of manure NH_3 emission in the barn	cat	%
	the ratio of manure NH_3 emission in the barn	dog	%
	the ratio of manure NH_3 emission in the barn	horse	%
	the ratio of manure N_2O emission in the barn	cat	%
	the ratio of manure N_2O emission in the barn	dog	%
	the ratio of manure N_2O emission in the barn	horse	%
	the ratio of manure excretion to urban green	cat	%
	the ratio of manure excretion to urban green	dog	%
	the ratio of manure excretion to urban green	horse	%
	fractions of N excreted in urban green leach to water	cat	%
	fractions of N excreted in urban green leach to water	dog	%
	fractions of N excreted in urban green leach to water	horse	%
	fractions of N excreted in urban green to waste	cat	%
	fractions of N excreted in urban green to waste	dog	%
	fractions of N excreted in urban green to waste	horse	%
horticulture	nitrogen content of irrigation water	nitrogen content of irrigation water	$kghm^{-2}a^{-1}$
	nitrogen content of decoration flowers	horticultural	%
	the ratio of animal manure to horticultural	pig（1-50 capita）	%
	the ratio of animal manure to horticultural	pig（>50 capita）	%
	the ratio of animal manure to horticultural	milk cow（1-5 capita）	%
	the ratio of animal manure to horticultural	milk cow（>5 capita）	%
	the ratio of animal manure to horticultural	meat cow（1-50 capita）	%
	the ratio of animal manure to horticultural	meat cow（>50 capita）	%

	the ratio of animal manure to horticultural	other cow（buffalo and yellow）	%
horticulture	the ratio of animal manure to horticultural	poultry breed with traditional household	%
	the ratio of animal manure to horticultural	egg Layer（>500 capita）	%
	the ratio of animal manure to horticultural	meat chicken（>2000 capita）	%
	the ratio of animal manure to horticultural	sheep and goat	%
	the ratio of animal manure to horticultural	horse	%
	the ratio of animal manure to horticultural	Mule and donkey	%
	the ratio of animal manure to horticultural	rabbit	%