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Annette Pronk[1], Marion de Vries[1], Witono Adiyoga[2], Nikardi Gunadi[2], Mathias Prathama[2], Agnofi E. Merdeka[2] & Joko Sugiharto[2]

1 Wageningen University & Research

2 Indonesian Vegetable Research Institute (IVEGRI)

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Key messages

Survey results on fertiliser practices of small-scale vegetable farmers in Lembang, West Java, showed that:

- The most frequently cultivated crops were broccoli, lettuce, tomato, Cayenne pepper, and cauliflower.
- More than 90% of the farmers used chicken manure (mainly 'postal': chicken manure with rice husks), and 13% of the farmers used cattle manure. Other organic fertilisers frequently used by farmers were goat manure and granulates of organic fertilisers.
- Fertilisers are applied at higher application rates and at higher costs in inter/multiple cropping systems than in mono cropping systems.
- There are many different organic fertiliser products used by farmers at an average application rate of 13 and 18 tons/ha at an average cost of 5.2 and 7.0 million IDR/ha in mono and inter/multiple cropping systems respectively.

Identified drivers for the use of chicken manure of small-scale vegetable farmers are:

- Low transportation costs of chicken manure,
- Chicken manure is easy to obtain,
- Chicken manure is easy to handle and apply,
- Neighbours are positive on the use of chicken manure.

Identified drivers and barriers for the use of cattle manure of small-scale vegetable farmers are:

- Farmers have in general a positive attitude towards the use of cattle manure, although less positive than towards the use of chicken manure. The most important driver is the belief that cold cattle manure does not burn their crops. Other important drivers are improved soil fertility, easier soil cultivation and increased crop yields by cattle manure use.
- Farmers feel discouraged by their social surroundings as farmers believe that people in their surrounding are in general negative on the use of cattle manure. Only neighbours are positive about cattle manure, and may thus stimulate farmers' adoption.
- Farmers' barriers to using cattle manure are:
  - Fresh, unfermented cattle manure damages my crop,
  - Transport of cattle manure is too difficult,
  - Cattle manure is often too wet,
  - Transport of cattle manure is too costly.
- Only a small number of respondents (41 of 322) used cattle manure, but the majority of the farmers (241 of 322) had a positive intention towards cattle manure use. This shows that many farmers would like to use cattle manure, when barriers are overcome.

To stimulate farmers with a positive intention on the use cattle manure, it is recommended to:

- Enhance a positive attitude towards the use of cattle manure of people in the social surroundings of farmers (referents),
- Organize demonstrations and focus group discussions on the use of cattle manure with neighbouring farmers with a positive intention,
- Improve the supply chain for cattle manure products (quality, transportation, - costs).

Executive summary

In Lembang Sub-District in West Java, Indonesia, most cattle manure is disposed to surface waters, causing environmental pollution and a loss of valuable nutrients. Small-scale vegetable farms on the other hand, have a high demand for manure products.
In this study 322 small-scale vegetable farmers in Lembang Sub-district were interviewed on their cultivation practices and fertiliser use, both chemical and organic fertilisers, on associated costs and on their believes on the use of chicken and cattle manure following the Theory of Planned Behaviour.

Results showed that fertilisation practices on small-scale-vegetable farms include a variety of different crops and that chemical and organic fertilisers were used at high application rates and at considerable costs. Considering the beliefs of farmers, results revealed that farmers have a strong positive attitude towards the use of manure products (chicken and cattle). The main drivers on the use of chicken manure were on a well-developed supply chain (low transportation costs, easy to obtain, to handle and apply) where the main drivers on the use of cattle manure were more of an agronomic nature (improved yields, improved soil fertility, easier soil cultivation). Most important findings were furthermore that people in farmers' social surroundings were in general not that positive on the use of both manure products. The main barriers on the use of cattle manure concentrate on the product supply chain: cattle manure is too fresh/unfermented and too wet. Furthermore, the transport of cattle manure is perceived to be too difficult and costly. Farmers with a positive intention towards the use of cattle manure may be stimulated to adopt the practice as the product composition/quality improves and farmers' surroundings become positive on the use of cattle manure. Adoption may also be facilitated by demonstrations on cattle manure use and focus group discussions with neighbouring farmers. To mitigate the identified barriers the supply chain of cattle manure must improve.

Ringkasan Eksekutif

Di Kecamatan Lembang, Jawa Barat, Indonesia, pupuk kandang sapi kebanyakan dibuang ke saluran drainase sehingga menimbulkan terjadinya polusi lingkungan dan menyebabkan hilangnya unsur hara yang berharga. Sementara itu, permintaan terhadap produk pupuk kandang sebenarnya sangat tinggi karena dibutuhkan sebagai salah satu input produksi usahatani sayuran petani skala kecil di sekitar lokasi. Penelitian ini melibatkan 322 petani sayuran skala kecil kecamatan Lembang yang diwawancarai untuk menghimpun data/informasi tentang praktek budidaya sayuran, terutama menyangkut penggunaan pupuk, baik kimiawi maupun organik, biaya pupuk yang harus dikeluarkan, serta sikap/kepercayaan petani terhadap penggunaan pupuk kandang ayam dan sapi menurut Teori Perilaku Terencana (*Theory of Planned Behaviour*). Hasil penelitian menunjukkan bahwa petani skala kecil di kecamatan Lembang menanam berbagai jenis sayuran dengan tingkat penggunaan pupuk kimia dan organik yang tinggi, serta pada tingkat pengeluaran biaya pupuk yang tinggi pula. Berkenaan dengan kepercayaan petani, hasil penelitian juga memberikan indikasi bahwa petani menunjukkan sikap positif yang sangat kuat terhadap penggunaan produk pupuk kandang (ayam dan sapi). Beberapa penghela utama penggunaan pupuk kandang ayam adalah adanya rantai pasok yang telah berkembang baik (biaya transportasi rendah, mudah diperoleh, mudah penanganan dan mudah diaplikasikan). Sementara itu, penghela utama penggunaan pupuk kandang sapi lebih bersifat agronomis (meningkatkan produktivitas, memperbaiki kesuburan lahan, mempermudah pengolahan lahan). Analisis lebih lanjut mengarah pada temuan terpenting yang memberikan gambaran bahwa lingkungan sosial petani secara umum bersikap kurang/tidak terlalu positif terhadap penggunaan pupuk kandang. Kendala utama penggunaan pupuk kandang sapi pada dasarnya bermuara pada rantai pasok yang belum berkembang baik, terutama berkaitan dengan produk pupuk kandang sapi yang terlalu segar/belum difermentasi dan terlalu basah. Hampir seluruh responden juga mempersepsi bahwa transportasi pupuk kandang sapi terlalu sukar dan mahal. Petani yang memiliki niatan positif tentang pupuk kandang sapi dapat didorong untuk mengadopsi penggunaannya jika komposisi/kualitas produk diperbaiki dan lingkungan sosial petani menunjukkan sikap positif terhadap penggunaan pupuk kandang sapi tersebut. Tingkat adopsi dapat difasilitasi/dipercepat melalui penyelenggaraan plot-plot demonstrasi penggunaan pupuk kandang sapi dan diskusi kelompok fokus dengan petani tetangga/sekitar. Untuk mengatasi kendala-kendala penggunaan yang telah diidentifikasi, perbaikan rantai pasok produk pupuk kandang sapi merupakan tindakan yang mutlak harus dilakukan.

1 Introduction

The 'Closing Regional Nutrient Cycles for Low-Emission Agriculture' project (2019-2021) aims to improve the regional nutrient use efficiency and reduce the greenhouse gas (GHG) emissions from agricultural systems in Lembang Sub-district (West Bandung district, West-Java, Indonesia), through increased use of cattle manure in crop production systems. The project develops a better understanding of the opportunities for closing the nutrient cycle between smallholder dairy farmers and small-scale vegetable (horticultural) farmers and by piloting these opportunities in practice. The project is funded by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), with financial support of the Dutch government.

The regional nutrient use efficiency in agricultural systems in Lembang Sub-district (West Bandung district, West-Java) is poor because most of the cattle manure is disposed to surface waters (Vries & Wouters 2017). Horticultural farmers in the region are familiar with manure products and use these products (Brink *et al.* 2016) and thus may be a suitable end user of cattle manure. But today, horticultural farmers in Lembang mainly use chicken manure based products whereas around 1970 and 1980, when chicken manure was hardly to not available, they used cattle manure. It is unclear why they currently do not use cattle manure anymore.

The first step of this project is therefore to characterize the fertilisation practices of horticultural farmers in Lembang, identify opportunities for cattle manure use, and drivers and barriers of horticultural farmers for the use of cattle manure. Additionally, farmers were asked about the drivers and barriers for the use of chicken manure, to better understand why this product is currently so widely adopted compared to cattle manure.
The above mentioned subjects were investigated through a farmer survey among a large group of small-scale vegetable farmers in Lembang.

The survey focused on the subjects mentioned below:
- What are the current crops cultivated?
- What are the fertilisation practices (e.g. type of fertiliser, application rates per crop)?
- What are farmers' perceptions of the value of cattle manure?
- What are farmers' main drivers and barriers on the use of chicken manure and cattle manure?

The results of this survey serve as a basis for the identification of options to increase adoption of the use of cattle manure in the region, and subsequently reduce the depositing to surface waters. Turning cattle manure into a commercial valued product increases regional nutrient use efficiency, reduces pollution of ground and surface waters, and reduces the GHG emissions from agricultural systems in the region.

2 Materials and methods

A survey was conducted in the fall of 2019 among 322 vegetable farmers in Lembang Sub-district in West Java, Indonesia.

2.1 Farmer selection

A pre-survey was conducted by the University of Padjajaran (UNPAD) at the DINAS Office of the BP3K District of Lembang, Kab. West Bandung, and among group leader farmers in Lembang Sub-District (snow-ball method) to make an inventory of horticultural farms in Lembang Sub-District. From the resulting list of 1738 horticultural farms, 360 farms were selected using simple random sampling of the total population of farmers (Annex 1). Hence, selected farms can be considered representative of the general population of Lembang Sub-District. Random selection of farms in villages was done jointly by IVEGRI and WUR. In the final survey 322 farmers were included.

2.2 Questionnaire

A questionnaire was developed by Wageningen Plant Sciences, based on input from Wageningen Livestock Sciences, IVEGRI, literature, minutes from workshops, and experts. The questionnaire consisted of four different parts:

1. general questions on farm management,
2. detailed questions on fertiliser use (chemical and organic fertilisers) to estimate a regional nutrient balance (not reported in this report),
3. questions to identify drivers and barriers of farmers on the use of chicken and cattle manure,
4. questions that allow the evaluation of greenhouse gas emissions of the farm management (not reported in this report).

The second part of the questionnaire is reported although the estimation of the regional nutrient balance will be reported in a later project phase. This also applies to the fourth part of the questionnaire.
The questionnaire was tested on 15 farmers by four enumerators of IVEGRI, and was then evaluated and improved. The open-ended questions in the test version of the questionnaire on benefits (drivers) and bottlenecks (barriers) of the use of chicken and cattle manure were evaluated and included in the appropriate sections as structured questions in the final questionnaire.
The final questionnaire was implemented in 322 farms by five enumerators of IVEGRI between September through November 2019 in 16 villages of Lembang. The five enumerators were evenly assigned to interview comparable number of farmers in each village, although one enumerator covered all 16 villages, three enumerators covered 15 villages and the remaining enumerator covered 12 villages.
Results were in Bahasa and translated to English for further processing.

2.2.1 General respondents characteristics

The general questions focussed on characteristics of respondents in the Lembang district. Gender, age, education, position in household, number of paid people working on the farm and farmers' membership of a union/club or corporation and its position were questions asked.

2.2.2 General farm characteristics and management

Questions on the farm characteristics focussed on area cultivated, its ownership and purpose of the cultivation. Furthermore, questions on keeping animals, the purpose of these animals, and questions related to the cultivated crops were asked. The crops mentioned were grouped into same groups as the University of Padjadjaran made in the pre-survey. Some crops did not fit in these groups and were processed as newly added groups. Farmers were also asked about their management practices such as planning date, chemical and organic fertiliser applications, costs of fertiliser products, total yields and sold yields.

2.2.3 Farmers perception on the use of manure

The paragraph *Methodology* is taken from Pronk *et al.* (Pronk *et al.* 2015). Small modifications were made for this study.

Methodology
The aim of this part of the questionnaire was to identify and improve on-farm compatibility of the use of manure, either chicken or cattle manure. To achieve this objective, we applied a behavioural approach, based on the theory of planned behaviour, to identify the main barriers and drivers of farmers towards adoption of the use of chicken or cattle manure. According to the theory of planned behaviour, individual beliefs about a behaviour or practice are believed to determine intention and behaviour (Ajzen 1988; 1991). The greater the intention to behave, the more likely one is to actually perform the behaviour, provided that the person has actual control over the behaviour. The intention of a farmer to implement a certain practice is determined by the degree to which implementing the practice is evaluated positively or negatively by the farmer (attitude), the feeling of social pressure from others (called referents) to perform or not perform a certain practice (subjective norm) and the subjective beliefs about the ease or difficulty of successfully performing the practice (perceived behavioural control, Figure 1).

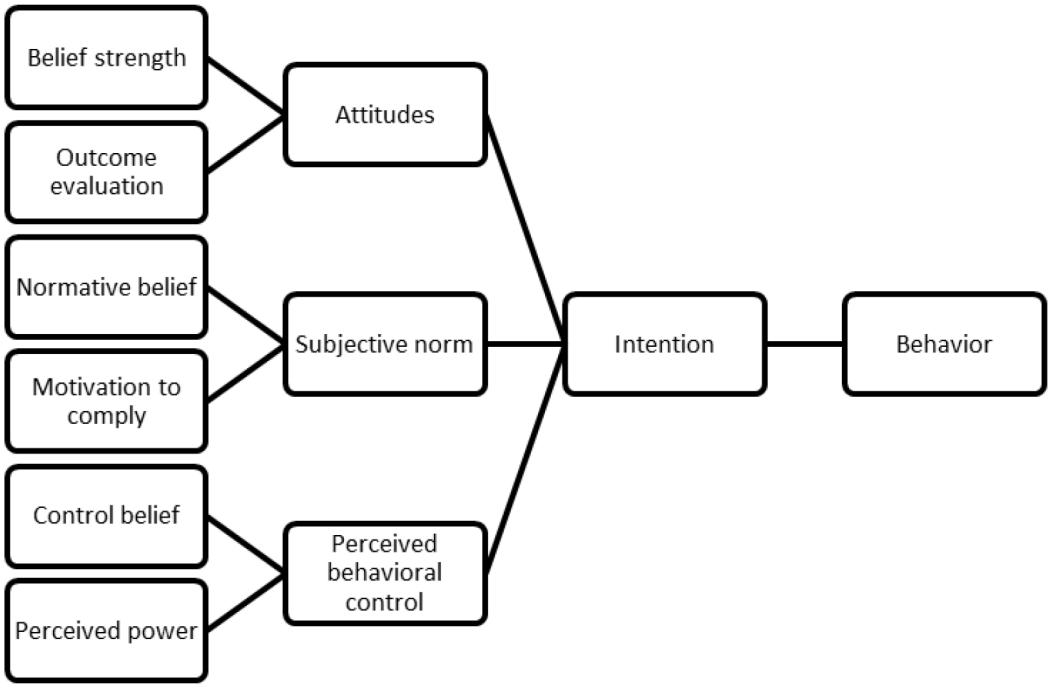

Figure 1 *Theory of planned behaviour, adapted from Ajzen (1991).*

According to the theory of planned behaviour, attitude is formed by the belief that the behaviour will be associated with a set of outcomes (belief strength, BS), weighted by an evaluation of these outcomes (outcome evaluation, OE). Subjective norm is thought to be a function of how much we perceive others (called referents) think we should perform the behaviour (normative belief, NB),

weighted by our motivation to comply with these referents (motivation to comply, MC). Finally, perceptions of behavioural control are determined by the belief that a set of control factors facilitate or obstruct the behaviour (control belief, CB), weighted by the expected impact that these factors would have if they were to be present (perceived power, PP).

The questions asked to identify the intention as a combination of attitude, subjective norm and perceived behavioural control of farmers to implementing the practice of is explained below.

Attitude
For the outcomes, farmers were asked to rate on a 1-7 point scale from 'completely false' to 'completely true' the probability of an outcome when implementing the management practice (*BS)*. Such a question is formulated as a statement of a belief of the management practice in a positive way, for example 'Cow manure increases my crop yields' [1 (not agree) – 7 (totally agree]. Then, farmers were asked to evaluate this outcome on a 1-7 point scale from 'very bad' to 'very good' (*OE*), for example 'An increased yield is … [1 (very bad) – 7 (very good)]'.

Subjective norm
For each referent, farmers were asked to indicate on a 1 – 7 point scale their perception of whether the referent thinks the farmer should implement the management practice (*NB*). An example is 'Neighbours are positive on the use of cow manure' [1 (not agree) – 7 (totally agree)]. Then farmers were asked to what extent they take into account the opinion of that specific referent (*MC*), for example: 'To what extent do you value the advice or opinion of neighbours?' [1 (not much) – 7 (very much)].

Perceived behavioural control
For the control factors, farmers were asked to rate on a 1–7 point scale the extent to which a control factor could hamper the implementation of the management practice (*CB*). Such a question is formulated as a statement of a belief of the management practice in a negative way, for example: 'Cow manure is too expensive' [1 (completely false) – 7 (completely true)]. Subsequently farmers were asked to what extent this control factor was applicable on his own farm (*PP*). An example is 'If cow manure were cheaper I start using it' [1 (completely false) – 7 (completely true)].

Combining attitude, subjective norm and perceived behavioural control, results in a positive or negative intention to actually perform the behaviour. All these underlying subjective beliefs influence a farmers' intention to adopt a certain practice, and are acting as cognitive drivers or barriers which encourage or discourage the farmer to adopt a specific practice.
Individual sets of questions (statement + statement evaluation) have a positive or negative value after processing (paragraph 2.3). The positive valued sets are called drivers where the negative valued sets are called barriers. Drivers and barriers can be found in attitude, subjective norm and perceived behavioural control although it is expected that drivers dominate attitude and barriers perceived behavioural control.

Management practices
The two management practices evaluated in this study are the use of chicken manure and the use of cattle manure. A short description of the management practices is needed to understand the nature of the questions on farmer's behaviour.
Farmers using chicken manure buy the product where farmers using cattle manure either use their own manure or receive it for free from their neighbour and only pay for transport to their fields. The chicken manure bought is all imported from outside the Lembang district, from for instance Garut or Subang. Some chicken manure traders have warehouses (stacked with manure) locally where other traders have to organise transport of the manure product from outside the Lembang district.
The two management practices were included each with a specific purpose. Our main interest was to investigate management practices, drivers and barriers of using cattle manure, as there is a strong interest in that study area to enhance the use of cattle manure in horticulture. As chicken manure is currently widely used, knowing management practices and identify drivers of using chicken manure can help to understand differences in the use of the two manure products, and may help to overcome barriers for using cattle manure.

Current practices of manure use

The cultivation of vegetables in Lembang is mainly done manually. Field preparation and seed bed preparation are done manually, as is manure mixing, manure application, fertiliser application (Figure 2), planting and crop maintenance (weeding, side dressing, irrigation, (Voort *et al.* 2018)).

Figure 2 *Mixing horse and chicken manure (left top), distributing (right top) and levelling (bottom left) mixed manure and applying fertilisers (bottom right) manually on beds/plots (Photo's from IVEGRI).*

Just before planting, both chemical and organic fertilisers are in general applied on beds as a top layer just before plastic mulch is used as a cover. Furthermore, fields in Lembang are not always accessible with motorised vehicles. Sometimes small or steep alleys have to be passed, or fields have simply no access road. This highly complicates the transportation options of farmers of any commodity and also of the removal of products (yields). Motor bikes are frequently used to transport production means to the field, including chemical and organic fertilisers (Figure 3).

Figure 3 *A motor bike used to transport bagged chicken manure to the field (Photo's from WPR).*

2.3 Data analysis

Data were cleaned from outliers. After data cleaning, general data analysis of the questionnaire was based on descriptive statistics to:

- describe the general characteristics of respondents,
- describe general characteristics of the farms and
- to describe means, median and frequencies of the prevalence of the subjective beliefs on the outcomes, referents and control factors.

The third bullet includes the attitude (A) which was indirectly measured by combining the farmers' belief on the likelihood of occurrence (*b*) of an outcome *i* and by its evaluation of these outcomes (*e*) in the following manner:

$$\mathrm{A} = \sum_{i=0}^{n} belief\ strength_i\ (outcome\ evaluation_i - 4)$$

in which *n*= the total number of outcomes that were involved in the questionnaire. In a similar way, subjective norms (*SN*) and perceived behavioural control (*PBC*) were determined as follows (Ajzen 1988; 1991):

$$\mathrm{SN} = \sum_{i=0}^{n} (normative\ belief_i - 4)\ motivation\ to\ comply_i$$

$$\mathrm{PBC} = \sum_{i=0}^{n} control\ strength_i\ (control\ power_i - 4)$$

For each indicator, A, SN, and PBC, the maximum score for each respondent varies between a maximum of 21 (driver) and -21 (barrier). The value 4 is related to rescaling the seven point scale from positive to negative values, that is an outcome evaluation with the value 1 ('very bad') now becomes -3 and results in a negative value, being barrier.
In this study, in order to identify differences in belief structure between adopters and non-adopters and between farmers with a positive versus negative intention, independent samples t-tests were performed. Adopters and non-adopters were identified by measuring behaviour as a simple dummy variable, being 1 if the farmer applied either chicken manure or cattle manure on at least one parcel of

his farm. Intention was measured using a latent-variable measurement scale consisting of three items. Each item took the form of a statement, to which the farmers indicated their degree of agreement on a scale from 1 to 7. The statements for the use of manure were 1) I will use manure on at least one of my fields next year; 2) Next year I will use manure on at least one of my fields and 3) On one of my fields I will use manure next year. Internal consistency was checked and found when farmers provided comparable answers to the three statements and measured by Cronbach's alpha (cut-off value of 0.7). If the median of farmers' intention was close to 4, a median split was taken to divide farmers into farmers with positive versus negative intention. If the median was not close to 4, high intenders were defined as those with an intention score higher than 4, and negative intenders were those with an intention score below 4.

3 Results and discussion

In the following paragraphs results are presented of average respondent characteristics and farm characteristics based on the interviews among 322 horticultural farmers in Lembang Sub-District. Also, the perception of farmers on the use of chicken manure and cattle manure are shown.

3.1 Respondents characteristics

The respondent's average age was 45 years and almost 10% was female. Male respondents were slightly (3 years) older than female respondents. Sixty-two percent finished the elementary school as highest education, 18% finished middle school, 16.5% finished higher school and 2.8% finished college. Only 2% of the respondents indicated that this highest education was related to agriculture. All respondents indicated to be in charge of the crop farming within the households. Twenty-six percent (n=83) of the households indicated that there were other sources of income besides the farming activities. In total, 26 different jobs were mentioned with merchant mentioned most, 27%. Secondly mentioned was construction with 10%. The average revenue from these jobs was estimated at 60% of the total household income with a maximum of 90% related to the job "barber" and a minimum of 30% related to the job of "civil servant" (1 respondent each).
Most respondents, 96%, were a member of some kind of farmers organisation, a farmers union, a farmer group or a farmer's corporation. In total, 56 different farmer organisations were mentioned by the respondents. Within these farmer organisations, different positions were practiced: 11% of the respondents were head of the organisation, 5% secretary, 3% treasurer and 81% member.

3.2 Farm characteristics

Area
The average cultivated area was 3,126 m^2 per farmer of which 98% was used for the production of horticultural crops and the remaining 2% for the production of fodder crops. Almost half of the land used for horticultural crops was owned by the farmers (46%; versus rented) which is in agreement with recent findings of De Vries et al (2017) for small-scale dairy farmers but smaller than for vegetable farmers in the late 1970's as found by Moll (1981) in Lembang. About 40% of the land was rented for the season or for a period of 1 year and the remaining 15% was rented for a longer period. With regard to fodder crops, 65% of the area was owned, and the remaining 36% was seasonably rented or rented for 1 year.

Horticultural crops
There are two distinct cropping systems in the Lembang region: mono cropping and inter or multiple cropping.
Mono cropping means that farmers cultivate one crop at the same time at a specific field or plot. In a mono cropping system different crops can be cultivated in rotation over the whole year.
Inter or multiple cropping is more complicated and basically means that farmers cultivate multiple (more than one) crops at the same time at a specific field or plot. This system is characterised by a great diversity. It can be that a farmer plants one or more crops at the same time, but also that he plants one crop and a second crop one week or sometime later in between the first crop, or that he plants three crops at the same or different times. Many vegetables have different growing periods before they are ready for harvest: some crops need 4 weeks from planting to harvest, e.g. Horenzo (Japanese spinach), where others may need more than 14 weeks (e.g. potato). Farmers sometimes plant two crops with a short growing period in between one crop with a long growing period, for instance lettuce and Chinese cabbage in between Broccoli or Cayenne Pepper with Eggplant, Cauliflower and Broccoli.

Many different inter/multiple cropping systems were found in the survey and showed that farmers use their fields intensively. Furthermore, these systems can only exist as most or all cultivation practices are manually.
Some of the fields are left bare in the dry season when irrigation is not available.

In this study we report about the latest harvested cultivation only. We start with results on land use of the mono cropping system and continue with results on land use of inter/multiple cropping systems as some results are not analysed for inter/multiple cropping systems.

Land use in the mono cropping system
Forty two percent of the farmers (n=134) cultivated the latest harvested crop in a mono cropping system. The most frequently cultivated crops were Broccoli, grown by 39 farmers followed by lettuce, 21 farmers, tomato, 14 farmers, and Chinese cabbage and string beans, both 9 farmers (Table 1). The largest average area cultivated with a specific crop by an individual farmer was with Romaine lettuce, almost 21,000 m^2, that is 21 ha (Table 1), followed by corn, 3,500 m^2, cassava, 2,800 m^2 and string beans, 2,403 m^2. The large area of Romaine lettuce was caused by one farmer that had 2,857 tumbak, being almost 40 ha. The smallest area of 630 m^2 was found for mustard green. These small areas for the production of vegetable crops are common (Pronk *et al.* 2018).
Broccoli was not only the most frequently cultivated crop, it also covered the largest area under cultivation, 75,880 m^2 (1946 m^2 * 39 times, Table 1) which was 27% of the total area in use in the mono cropping system. Romaine lettuce was cultivated in total on 41,118 m^2 which was 14.5% of the area, lettuce on 35,770 m^2 (12.6%) and tomato on 31,010 m^2 (10.9%). These four crops accounted for 65% of the area under cultivation in the mono cropping system.

Land use in inter/multiple cropping systems
Fifty eight percent of the farmers (n=188) cultivated the latest harvest in an inter/multiple cropping system. The majority of these farmers (n=144) cultivated two crops and 44 farmers cultivated three crops in the inter/multiple cropping system. It is not possible to provide exact individual area's for crops as the proportion of the area cultivated with a specific crop was not indicated. The area's for the inter/multiple cropping systems presented in Table 1 are area's under cultivation of two or three crops. The most frequently cultivated crops were lettuce, grown by 73 farmers, followed by broccoli, 68 farmers, tomato, 65 farmers and Cayenne pepper, 61 farmers.
The largest average area cultivated by farmers was with coffee, 7,000 m^2, followed by asparagus, 6,160 m^2, mustard green 3,698 m^2 and eggplant 3,469 m^2.
Although lettuce was the most frequently cultivated crop in the inter/multiple cropping systems, tomato covered the largest area under cultivation, 18,8426 m^2 (2,899 m^2 * 65 times, Table 1) which was almost 20% of the total area in use in inter/multiple cropping systems. Cayenne pepper was cultivated on 16,5480 m^2 which was almost 17% of the area, broccoli on 14,4816 m^2, almost 15% and lettuce on 13,2174 m^2 (13.5%). These four crops accounted for 65.5% of the area under cultivation in inter/multiple cropping systems.
This results in As only the first crop of the inter/multiple cropping system is included into this analysis, care should be taken by the interpretation of the results. The area * crop combination may be higher than expressed here as for instance tomato plus lettuce shows as tomato where lettuce plus tomato shows as lettuce, but these two combinations are basically the same.

Yields of both cropping systems varied largely, from failed crops (no yield) to 38,571 kg/ha for Zucchini and over 50,000 kg/ha for Beef Tomato in the mono and inter/multiple cropping systems respectively.

Table 1 *The area cultivated, yield sold and total yield in the two cropping systems per crop.*

Crop	Area [m²]				Yield sold[kg/ha]		Total yield [kg/ha]	
	Mono	n[1]	Inter/multiple[2]	n	Mono	Inter/multiple	Mono	Inter/multiple
Asparagus	-[3]		6,160	2	-	268[4]	-	283[4]
Beef Tomato	-		224	2	-	49,320	-	50,723
Beet root	-		666	5	-	6,946	-	6,986
Broccoli	1,946	39	2,130	68	5,066	8,545	5,338	9,303
Cabbage	2,345	8	2,266	8	9,177	12,160	9,268	12,566
Cassava	2,800	1			*[5]	-	*[5]	-
Cauliflower	1,540	7	2,072	31	8,253	16,620	8,346	17,136
Celery	1,155	2	1,960	2	900	714	1,060	714
Chinese cabbage	1,761	9	2,945	11	4,329	20,509	5,958	23,655
Coffee	-		7,000	1	-	0	-	0
Coriander	2,100	1	1,260	1	136	1,587	136	1,587
Corn	3,500	1	-		0[6]	-	0[6]	-
Cucumber	-		2,100	2	-	36,429	-	36,964
Eggplant	1,120	1	3,469	9	18,304	23,636	18,750	24,305
Golden berry	700	3	-		2,917	-	3,177	-
Horenzo (Japanese spinach)	1,097	6	879	8	3,000	8,503	3,373	8,668
Kaboca (Sweet pumpkin)	-		3,127	3	-	5,000	-	5,129
Kailan (Chinese Broccoli)	-		1,120	1	-	*[5]	-	*[5]
Kyuri (Cucumber)	-		1,750	2	-	14,762	-	15,040
Lettuce	1,703	21	1,811	73	6,167	9,710	6,488	10,353
Lollo Rossa	-		350	1	-	2,857		2,857
Long bean	-		2,800	1	-	2,500		2,714
Mustard Green	630	5	3,698	9	7,148	14,400	7,402	15,160
Pepper, Cayenne	1,645	2	2,713	61	1,580	4,472	1,601	4,860
Pepper, curly hot	-		1,155	4	-	14,371		14,915
Pepper, hot	1,400	1	2,552	13	306	2,359	306	2,525
Pepper, Jalapeno	1,400	1	-		969	-	1,020	-
Radish	840	2	1,680	1	7,245	23,810	7,806	24,405
Romaine Lettuce	20,594	2	2,108	16	773	6,017	803	6,330
Spring onion	-		2,450	1	-	1,633	-	2,041
Strawberry	-		1,400	1	-	3,000	-	3,571
String bean	2,403	9	2,574	15	4,130	7,016	4,323	7,230
Tomato	2,215	14	2,899	65	20,272	27,148	22,114	30,102
Zucchini	1,400	1	2,065	4	38,571	3,132	39,286	3,411

[1] number of observations; [2] area's indicated shared with at least one other crop; [3] not cultivated; [4] harvest not finished; [5] not harvested yet; [6] crop failed.

Animals and purposes

Slightly more than 29% of the respondents (94 of the 322 farmers) had animals. About half of these farmers with animals had an average of 4.1 dairy cows, mostly for commercial use (37 out of 38 farmers). Goats and sheep, with an average of 7.5 animals per farmer, were kept by 32 farmers and 91% of the farmers indicated that they had those animals for commercial use. Third in line were broilers (for chicken meat), owned by 14 farmers with an average of 367 animals each. Almost 30% of these farmers kept broilers for commercial use, the others for home consumption. Other animals kept by farmers were rabbits (6 farmers, 15.5 rabbits per farmer, 33% for commercial use), quails (5 farmers, 1010 quails per farmer, 80% for commercial use), beef cattle (2 farmers), laying hens (1 farmer), a horse (1 farmer) and birds (1 farmer).

Chemical fertiliser use

A large variety of different chemical fertilisers is used by the farmers, more than 38 different products were mentioned and total application rates of nitrogen (N), phosphate (P_2O_5) and potassium (K_2O) were calculated using the chemical composition of the products mentioned (Sarwani 2016). Fertiliser products that did not contain one of the macro nutrients nitrogen, phosphate or potassium were not included, of which boron was mostly mentioned. For the 38 products the application rates of N, P_2O_5

and K_2O were calculated per cropping system per crop (Table 2). The mean application rate of chemical N was 81 kg/ha the in mono cropping system and almost twice as much in inter/multiple cropping systems. Comparable application rates were found for chemical P_2O_5 and K_2O, with application rates being much higher in inter/multiple cropping systems than in mono cropping systems (Table 2).
In the analysis of inter/multiple cropping systems all cultivated crops are listed and fertiliser applications (both chemical and organic), are assigned to each individual crop. For instance, the fertiliser applications for broccoli grown with lettuce (inter cropping system) are appointed to broccoli as well as to lettuce. This may lead to an overestimation of the average fertiliser application rate, the mean value of Table 2 and Table 3 because if broccoli intercropped with lettuce is heavily fertilised they may dominate when counted both as individual crops in the average value. However, differences when only the first crop was included in the mean value of inter/multiple cropping systems, were small for N, (150 kg n/ha compared to 154 kg/ha) and K_2O (127 kg/ha compared to 130 kg /ha), and around 11 kg/ha for P_2O_5 (175 kg/ha compared to 186 kg/ha).

For some vegetable crops fertiliser guidelines can be found. For tomato, an application of organic amendments of 20-30 tons/ha is recommended with 60, 115 and 120 kg/ha of N, P_2O_5 and K_2O respectively as a basal dressing and a side dressing of 60 kg N/ha (Moekasan *et al.* 2015). For cabbage, an application of organic amendments of 20-30 tons/ha is recommended with 110, 110 and 180 kg/ha of N, P_2O_5 and K_2O respectively as a basal dressing and a side dressing of 110 kg N/ha. The fertiliser applications found for tomato in this study are higher and for cabbage in line or lower, depending on the nutrient. The application rates practices in this study are in agreement with previous studies on farmer fertilisation practices (Voort *et al.* 2018).

Table 2 *The application of chemical nitrogen (N), phosphate (P_2O_5) and potassium (K_2O, kg/ha) and the number of observations (n) per cropping system and crop. Each crop of inter/multiple cropping systems is indicated.*

Crop	Cropping system							
	Mono				Inter/multiple			
	N	P_2O_5	K_2O	n	N	P_2O_5	K_2O	n
Asparagus	-[1]	-	-		119	176	39	2
Beef Tomato	-	-	-		134	422	344	2
Beet root	-	-	-		46	220	132	5
Broccoli	87	84	81	39	131	171	123	68
Cabbage	104	76	85	8	236	120	96	8
Cassava	0	0	0	1	-	-	-	
Cauliflower	80	139	94	7	135	157	131	31
Celery	111	64	70	2	156	246	48	2
Chinese cabbage	56	52	40	9	177	187	140	11
Coffee	-	-	-		71	114	11	1
Coriander	57	30	30	1	179	179	179	1
Corn	61	71	46	1	-	-	-	
Cucumber	-	-	-		147	205	54	2
Eggplant	442	304	143	1	249	170	117	9
Golden berry	60	139	126	3	-	-	-	
Horenzo (Japanese spinach)	27	31	32	4	151	251	205	8
Kaboca (Sweet pumpkin)	-	-	-		48	48	48	3
Kailan (Chinese Broccoli)	-	-	-		202	316	43	1
Kyuri (Cucumber)	-	-	-		690	536	231	2
Lettuce	70	108	86	22	126	150	119	72
Lollo Rossa	-	-	-		71	24	32	1
Long bean	-	-	-		218	171	221	1
Mustard Green	29	44	29	5	202	403	257	9
Pepper, Cayenne	84	94	58	2	184	217	142	61
Pepper, curly hot	-	-	-		246	262	124	4
Pepper, hot	7	3	7	1	193	252	155	13
Pepper, Jalapeno	246	300	171	1	-	-	-	
Radish	11	0	11	1	37	27	10	1
Romaine Lettuce	34	28	34	2	87	118	98	16
Spring onion	-	-	-		140	131	140	1
Strawberry	-	-	-		114	103	115	1
String bean	50	63	56	9	94	89	76	15
Tomato	130	228	124	14	180	218	145	65
Zucchini	93	106	66	1	29	65	40	4
Mean	81	100	77		154	186	130	

[1] No crop cultivated or not fertilised.

Organic fertiliser use

A large variety of different organic fertilisers was used by farmers, 20 different products were mentioned (Table 3). Many of these products were used by one farmer only. In total 86% of the farmers used at least one type of organic fertiliser. The most frequently used product was 'chicken manure with rice husks postal'; 74 farmers used this product in the mono cropping system and 102 farmers in inter/multiple cropping systems. In total slightly more than 70% of the farmers (n=229) used some form of chicken manure, and 12% of the farmers used some form of cattle manure. Few farmers used a mixture of chicken manure and cattle manure (4%). Other organic fertilisers frequently used by farmers were goat manure (9% of the farmers) and Subur Ijo organic fertiliser (5%), a granulated organic fertiliser[1]. Cattle manure was used in many forms, including: cattle manure with compost, solid cattle manure from a heap with or without plant materials, vermi-compost (worms), cattle manure mixed with chicken manure, and cattle urine.

[1] www.greenplanet.co.id/index.php/ind/single?id=36&category=Subur+Ijo

Application rates varied which is understandable as the products differ in e.g. nutrient contents, costs, or ease of handling and transportation. Solid products were in general applied in higher doses than liquid products. The widely used chicken manure product was applied in high amounts; approximately 21 and 28 tons/ha to the crop depending on the cropping system being the highest amount in the mono cropping system. These application rates are in agreement with recommendations for several vegetable crops of 20 to 30 tons/ha (Moekasan *et al.* 2015). Most products were use at higher doses in inter/multiple cropping systems than in the mono cropping system. The highest dose in inter/multiple cropping systems was found for 'Cattle solid manure from heap without plant materials' and was almost 40 tons/ha.
On average, when organic products were applied, the dose was 13 and 17 tons/ha in mono and inter/multiple cropping systems respectively.

The costs for organic fertiliser products applied to the most recent harvest varied from 0.03 to almost 9 million IDR/ha in mono cropping systems to 0.3 to almost 18 million IDR/ha in inter/multiple cropping systems (Table 3). High costs per ha (e.g. for chicken manure with rice husks, mixture of cattle and chicken manure; Table 3) were mainly related to high application rates of these products. The costs for the most frequently applied product, chicken manure with rice husks, was about 8 and 9.5 million IDR/ha in the mono and inter/multiple cropping systems respectively. Chicken manure with rice husks postal is a commonly available product in West Java and frequently used by potato farmers at comparable application rates and costs (Pronk *et al.* 2017).

Table 3 *Application rates [kg/ha] and costs [10^6 IDR/ha] of different organic fertiliser products for the two cropping systems.*

Crop	Mono			Inter/multiple		
	Rate	Costs	n	Rate	Costs	n
Biogreen	-	-		36	1.79	1
Cattle compost after mixing and turning	6,008	3.78	4	10,714	-[3]	1
Cattle manure	5,000	3.33	2	-	-	
Cattle manure + chicken manure + rice husks postal	17,980	5.88	4	19,180	5.95	10
Cattle manure + compost	-	-		14,271	4.76	1
Cattle solid manure from heap + plant materials	7,874	1.59	3	10,754	2.97	6
Cattle solid manure from heap - plant materials	3,571	0.54	3	39,286	7.14	2
Cattle urine	-	-		179	0.89	1
Chicken manure from rooster	3,633	2.82	14	3,844	3.25	20
Chicken manure - rice husks batere	3,672	2.57	14	7,306	4.54	16
Chicken manure + rice husks postal	20,449	7.10	74	27,288	9.37	102
Goat manure	11,041	3.97	12	7,503	2.19	14
Goat manure liquid	143	-	1	-	-	
Goat manure + rabbit urine	16,071	0.27	1	1,607	0.27	1
Horse manure	4,286	0.71	1	-	-	
Liquid organic fertiliser	3	0.03	1	2,186	17.88	3
Rabbit manure	-	-		11,905	-	1
Rabbit urine	190	0.19	2	268	-	1
Subur Ijo organic fertiliser	1,081	2.41	5	1,443	3.03	11
Vermi-compost (worms)	5,643	5.06	9	2,898	2.74	8
Mean[2]	13,102	5.18		17,596	7.01	

[1] not applied; [2] weighted mean for costs based on slightly different number of registrations as not all costs were reported; [3] no costs indicated.

The application rates of the organic fertilisers per crop are listed in Annex 2 and the related costs for products are listed in Annex 3. Organic fertiliser products were grouped into 4 categories of products, those containing only cattle manure (Cattle), those containing a combination of cattle and chicken manure (Cattle + Chicken), those containing only chicken manure (Chicken) and others (Other; goat, rabbit, liquid, …). Application rates and -costs of these categories for the 4 crops with the largest area in Lembang Sub-District are summarised in Figure 2.1 and Figure 2.2 for the mono and inter/multiple cropping systems respectively.

In the mono cropping system Romaine lettuce received only Chicken at the largest dose of 35 tons/ha and at considerable costs of almost 12 million IDR/ha. Cattle + Chicken was applied to broccoli at an application rate of 25 tons/ha, followed by Chicken, 15 tons/ha and a small dose of Cattle of slightly more than 5 tons/ha. Costs for these applications varied between 0.7 million IDR/ha for Cattle to 9 million IDR/ha for Cattle + Chicken. Lettuce received all four categories of which Chicken was applied at the largest dose of slightly more than 15 tons/ha, shortly followed by Cattle + Chicken at almost 12 tons/ha and an application of almost 5 tons/ha of Cattle. Cost for Cattle application were much higher for lettuce than for broccoli of comparable doses, 3.3 million IDR/ha compared to 0.7 million IDR/ha respectively. Tomato was fertilised with Chicken and a variety of other organic products grouped into Other.

Doses and costs in inter/multiple cropping systems were comparable to those of the mono cropping systems. In inter/multiple cropping systems the crops with the largest cultivated area received Cattle + Chicken and Chicken of which broccoli and lettuce received the highest doses, slightly over 30 tons/ha, at the highest costs, slightly over 10 million IDR/ha. Tomato on the other hand, did not receive Cattle, although Cattle + Chicken was applied to Tomato in inter/multiple cropping systems at 5.4 tons/ha and not in the mono cropping system.

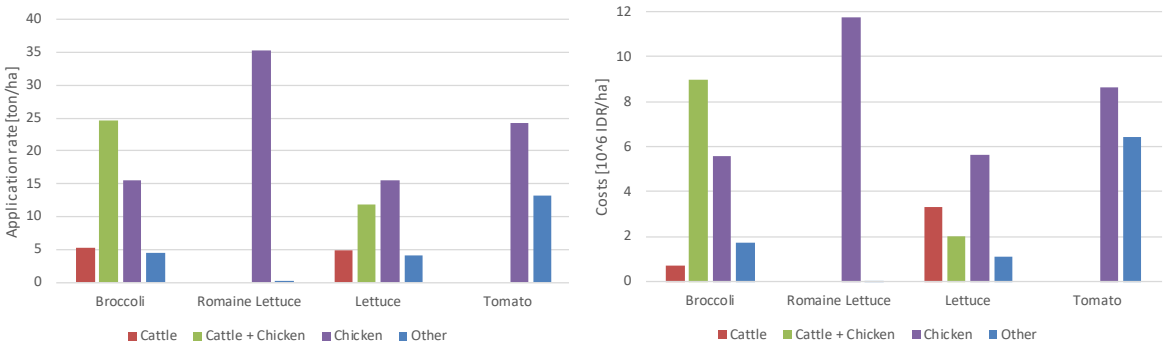

Figure 4 *Application rates [ton/ha, left] and expenses [10^6 IDR/ha, right] of organic fertilisers for most important crops in Lembang Sub-District in the mono cropping system.*

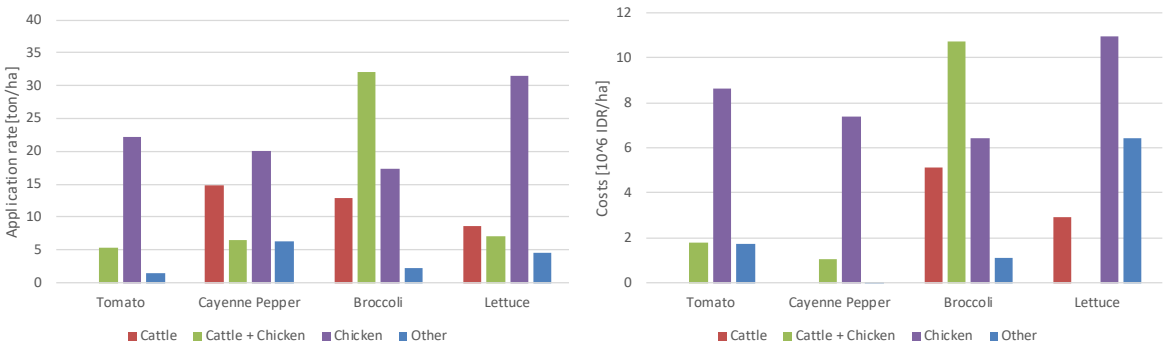

Figure 5 *Application rates [ton/ha, left] and expenses [10^6 IDR/ha, right] of organic fertilisers for most important crops in Lembang Sub-District in inter/multiple cropping systems.*

Organic fertilisers decompose after application. During decomposition, N is the most important nutrient that becomes available for crop uptake. From chicken manure, approximately half of the applied total N mineralises during the first three months after application (Brink *et al.* 2016). The chemical fertilisers applied by farmers do not appear to be corrected for this mineralisation of N from organic fertilisers. Although the nutrient application rates for N, P_2O_5 and K_2O of organic fertilisers are not estimated in this study, Brink et al (2016) showed that with an application of 15 tons/ha of chicken manure with rice husks postal in the wet growing season, 100 to 235 kg N/ha mineralises during a three months cultivation period. In the dry season 10 tons/ha were applied, with estimated

mineralisation of 75 to 80 kg N/ha. In addition, most farmers apply organic fertilisers more than once per year, which builds up the general soil fertility and mineralisation of N.

3.3 Farmers perceptions on the use of manure

Two types of manure use were investigated with regard to farmers' perceptions: chicken manure and cattle manure. For each manure type a set of questions was asked (see par. 2.2.3). For both sets the consistency score (Cronbach's α) was high enough to draw reliable conclusions from the data (Table 4), although the consistency score for the use of chicken manure was on the boundary of acceptance (cut off point 0.7).

The analysis done and presented below show three result paragraphs; results of the total dataset (paragraph *Beliefs*, n=322, detailed results in Annex 4, 5); results of the dataset split into so called 'adopters' (A), those who apply the practice, and so called 'non-adopters' (NA) being those who do not apply the practice (paragraph *Intention and behaviour*, detailed results in Annex 6); and results of the dataset split into so called 'intenders' (I) and so called 'non-intenders' (NI), based on the median of the consistency score (paragraph *Positive versus negative intention*, detailed results in Annex 7*)*.

Slightly more than 90% of the farmers indicated to use chicken manure (A = 290) and other farmers indicated not to use chicken manure (NA = 32). This confirms that chicken manure is a commonly used product and differences between adopters and non-adopters and between intenders perceptions and non-intenders perceptions, are not considered further. Almost 13% of the farmers indicated to use cattle manure (A = 41, NA = 281).
The intention score for the use of cattle manure was sufficiently high to evaluate intenders perceptions and compare those with non-intenders perceptions. The median was close to 4 and used to split the dataset into farmers with a positive intention (above the median) and farmers with a negative intention (below the median). Two hundred forty one farmers expressed a positive intention towards the use of cattle manure and 81 farmers expressed a negative intention.

Table 4 *Statistical data on consistency and intention for the use of manure.*

Manure type	Cronbachs α	n	Mean	STD	Median	Frequency distribution (%)						
						[0-1] 1	[1-2] 2	[2-3] 3	[3-4] 4	[4-5] 5	[5-6] 6	[6-7] 7
Chicken manure	0.69	322	5.68	0.93	6.00	1	2	5	19	38	186	71
Cattle manure	0.83	322	4.46	1.18	4.33	2	9	30	110	67	89	15

3.3.1 The use of chicken manure

Beliefs
The overall attitude of farmers towards chicken manure is very positive, expressed by high values for each question in Table 5. Farmers strongly believe in the positive aspects of the use of chicken manure, in particular that chicken manure is cheap to transport, that it is easy to obtain and that it is easy to handle and apply (Table 5). These positive beliefs of this practice are the main drivers for farmers for the use of chicken manure.

Evaluating the subjective norm, the results show that farmers feel only stimulated by neighbours and farmer group discussion, identified by the positive values in Table 5. This allows referents to advocate the use of chicken manure to promote adoption of the practice. Farmers are also motivated to comply with extension agents, demonstrations from research and pest observers, but these referents are all negative on the use of chicken manure and thus qualify as barriers.

As expected, no drivers were found for perceived behavioural control.

Table 5 *Drivers for the use of chicken manure.*

Type	Topic	Mean	STD	MEDIAN
Attitude	Transporting chicken manure is cheap	16.50	5.29	18
	Chicken manure is easy to obtain	15.17	5.09	14
	Chicken manure is easy to handle and apply	14.11	4.63	14
	Chicken manure is easier to use than cattle manure	13.94	4.72	14
	Transporting chicken manure is easy	13.69	5.67	14
	Chicken manure increases my yield	13.35	4.32	12
	Chicken manure is good for the soil fertility of my fields	12.93	4.21	12
	Soil cultivation is easier when using chicken manure	12.02	4.65	12
	Chicken manure increases yields more than cattle manure	10.13	4.42	9
Subjective norm	Neighbours are positive on the use of chicken manure	7.50	6.87	10
	The use of chicken manure is positively discussed in group meetings with other farmers	0.59	9.39	0

3.3.2 The use of cattle manure

Beliefs

The overall attitude of farmers towards the use of cattle manure is positive, expressed by high positive values in Table 6. Farmers strongly believe in the positive aspects (drivers) of the use of cattle manure, particularly that cold cattle manure does not burn their crops, that cattle manure improves soil fertility and increases yields. However, one negative aspect (barrier) is also identified: crop damage due to the use of fresh/unfermented cattle manure (high negative value, Table 7).
Taking into account farmers perception on potential effects of using cattle manure (outcomes e.g. not agree or agree) and how they evaluate potential outcomes (good or bad), the main drivers to implement the use of cattle manure are related to the effects on increased soil fertility and the increased yields. They stress the importance of using fermented/cold cattle manure: see the high positive value on the question 'Cattle manure is cold (not hot) and does not burn my crops' as driver and the high negative value on the question 'Fresh/unfermented cattle manure damages my crops' as a barrier. Both results strongly stress the importance of using fermented/cold cattle manure.

Evaluating subjective norm, results show that farmers feel hardly stimulated by any referent to use cattle manure. Farmers do not believe that referents talk in favour of the use of cattle manure, shown by negative values in Table 7. But, they feel stimulated by their neighbours on the use of cattle manure (positive value in Table 6). This might be related to the increasing pressure of citizens on farmers to avoid cattle manure disposal into the environment, which causes nuisance and environmental pollution. Neighbours can play a stimulating role in the use of cattle manure by farmers which may lead to increased adoption.

Table 6 *Summarised results of drivers for the use of cattle manure for Attitude and Subjective norm and the underlying components Belief Strength and Outcome evaluation, and Normative belief and Motivation to comply.*

	Belief Strength		Outcome Evaluation		Attitude	
Outcome	Mean	std	Mean	std	Mean	std
Cold cattle manure does not burn my crops	5.07	1.15	6.74	0.70	13.96	4.85
Cattle manure improves the soil fertility of my fields	5.29	1.14	6.39	0.59	12.71	4.29
Cattle manure increases my crop yields	5.22	1.14	6.40	0.56	12.59	4.09
Cattle manure increases yields more than chicken manure	4.70	1.40	6.40	0.56	11.34	4.32
Soil cultivation is easier when using cattle manure	4.71	1.43	6.14	0.67	10.18	4.71
Cattle manure is available anytime	4.13	1.82	6.44	0.69	10.07	5.54
Cattle manure is easy to obtain	4.18	1.72	6.34	0.73	9.81	5.27
Cattle manure is easy to handle and apply	3.17	1.55	6.23	0.67	7.05	4.14
Cattle manure is easier to use than chicken manure	2.55	1.19	6.23	0.67	5.68	3.36
	Normative belief		Motivation to comply		Subjective norm	
Referent	Mean	std	Mean	std	Mean	Std
Neighbours are positive on the use of cattle manure	4.59	1.51	5.30	1.11	3.49	8.16

The results for perceived behavioural control show many barriers on the use of cattle manure, see negative values in Table 7. Identified barriers are the belief that transport of cattle manure is too difficult, that cattle manure is often too wet and too costly to transport, that it is often not properly packed and that handling and applying is too difficult.

Table 7 *Summarised results of barriers for the use of cattle manure for Attitude, Subjective norm and Perceived behavioural control and the underlying components Belief Strength and Outcome evaluation; Normative belief and Motivation to comply; and Control belief and Perceived power.*

	Belief strength		Outcome evaluation		Attitude	
	Mean	std	Mean	std	Mean	std
Fresh/unfermented cattle manure damages my crops	5.55	1.24	1.34	0.86	-14.78	6.21
	Normative belief		Motivation to comply		Subjective norm	
	Mean	std	Mean	std	Mean	std
Agrishops promote the use of cattle manure	1.48	0.88	3.54	1.85	-8.59	5.99
Demonstrations from research show that cattle manure is beneficial for my crop	2.49	1.52	4.88	1.33	-7.02	7.93
Brochures promote the use of cattle manure	1.58	1.00	2.98	1.65	-6.85	5.37
The positive effects of the use of cattle manure is emphasized by promotion/salesman	1.48	0.81	2.78	1.67	-6.73	4.92
Radio and tv are positive on the use of cattle manure	1.67	1.11	2.85	1.69	-6.07	5.34
Pest observers are positive on the use of cattle manure	2.97	1.59	4.72	1.33	-4.48	8.00
Extension agents advise the use of cattle manure	3.61	1.70	5.27	1.10	-1.41	9.16
The use of cattle manure is positively discussed in group meetings with other farmers	3.81	1.70	5.44	1.09	-0.82	9.36
	Control belief		Perceived power		Perceived behavioural control	
	Mean	std	Mean	std	Mean	std
Transporting cow manure is too difficult	6.08	1.07	1.93	0.90	-12.84	6.36
Cow manure is often too wet	5.96	1.11	2.12	1.03	-11.30	7.01
The transport of cow manure is too costly	6.04	1.15	2.25	1.13	-10.84	7.82
Cow manure is often not properly packed	6.00	1.18	2.30	0.99	-10.36	6.75
Handling and applying cow manure is too difficult	5.88	1.21	2.30	1.04	-10.08	6.96
Cow manure is often too heavy	6.14	0.88	2.47	1.14	-9.64	7.67
I am unfamiliar with the use of cow manure	4.52	1.90	2.46	1.39	-7.52	7.32
Cow manure is too expensive	3.91	1.76	2.40	1.16	-6.41	6.07
Cow manure is not available in my neighbourhood	3.92	2.04	2.64	1.38	-5.63	6.84
The benefits of using cow manure are not clear to me	3.74	1.84	3.15	1.65	-4.08	6.73
I use my own chicken manure	1.28	0.66	3.43	1.65	-0.62	2.32

Intention and behaviour

The following results present the differences and similarities in beliefs between adopters (41 farmers) and non-adopters (281 farmers) on the use of cattle manure. Results shown present only the significant differences between adopters and non-adopters for belief strength, normative belief and motivation to comply as well as for the outcome evaluation, motivation to comply and perceived power.

Striking is that the main drivers for the use of cattle manure were more strongly believed by non-adopters than by adopters, meaning that non-adopters more strongly believed that cattle manure is easy to handle and to apply, also easier than chicken manure, that it is easy to obtain and available any time (Table 8). However, the importance of these effects (outcomes) were evaluated equal between the groups. This means that both adopters and non-adopters agreed on the outcome being either good or bad.

In addition, non-adopters were more stimulated by demonstrations from research, neighbours and promotion/salesman than adopters where both groups felt the same motivation to comply with the referents (Table 8).

Farmers shared the beliefs on control factors. However, most beliefs were more of a bottleneck to adopters than non-adopters (higher mean value of adopters compared to non-adopters in Table 8). But, when looking at the perceived power, adopters seemed less bothered by the difficult transport than non-adopters. On the other hand, using their own chicken manure and the availability of cattle manure were more or a bottleneck to adopters than non-adopters.

Table 8 *Summarised results for Belief strength and Outcome evaluation, Normative belief and Motivation to comply, Control belief and Perceived power of adopters (n=41) and non-adopters (n=281) of farmers on the use of cattle manure. (Yellow indicates significant higher at the 5% level).*

	Belief strength				Outcome evaluation			
	Adopters		Non-adopters		Adopters		Non-adopters	
Outcome	Mean	Std	Mean	std	Mean	std	Mean	std
Cattle manure is easy to handle and apply	3.05	1.50	4.05	1.61	6.22	0.67	6.24	0.66
Cattle manure is easier to use than chicken manure	2.46	1.16	3.20	1.21	6.22	0.67	6.24	0.66
Cattle manure is easy to obtain	4.07	1.73	4.95	1.50	6.35	0.71	6.32	0.91
Cattle manure is available anytime	4.02	1.82	4.90	1.58	6.44	0.65	6.44	0.90
	Normative belief				Motivation to comply			
	Adopters		Non-adopters		Adopters		Non-adopters	
Referent	Mean	Std	Mean	std	Mean	std	Mean	std
Demonstrations from research show that cattle manure is beneficial for my crop	2.39	1.50	3.17	1.50	4.85	1.36	5.07	1.17
Neighbours are positive on the use of cattle manure	4.51	1.56	5.20	1.01	5.29	1.14	5.32	0.88
The positive effects of the use of cattle manure is emphasized by promotion/salesman	1.44	0.76	1.73	1.07	2.81	1.70	2.54	1.43
	Control belief				Perceived power			
	Adopters		Non-adopters		Adopters		Non-adopters	
Control factor	Mean	Std	Mean	std	Mean	std	Mean	std
Transporting cattle manure is too difficult	6.15	0.97	5.56	1.50	1.84	0.78	2.59	1.30
Cattle manure is often not properly packed	6.09	1.12	5.37	1.39	2.31	1.02	2.22	0.72
I am unfamiliar with the use of cattle manure	4.80	1.79	2.59	1.48	2.46	1.42	2.44	1.16
Cattle manure is too expensive	4.04	1.77	3.05	1.48	2.44	1.19	2.12	0.90
I use my own chicken manure	1.26	0.57	1.39	1.07	3.58	1.64	2.39	1.38
The benefits of using cattle manure are not clear to me	3.88	1.83	2.76	1.58	3.11	1.63	3.44	1.75
Cattle manure is not available in my neighbourhood	4.12	2.03	2.59	1.56	2.72	1.42	2.10	0.80
Transporting cattle manure is too costly	6.17	1.01	5.20	1.63	2.28	1.15	2.02	1.01
Cattle manure is often to heavy	6.20	0.81	5.68	1.17	2.47	1.14	2.44	1.12
Handling and applying cattle manure is too difficult	6.00	1.12	5.10	1.53	2.30	1.04	2.29	1.08

Positive versus negative intention

The following results present the differences and similarities in beliefs between farmers with a positive (241 farmers) versus negative (81 farmers) intention towards the use of cattle manure. Results shown present only the significant differences between farmers with a positive and negative intention for belief strength, normative belief and motivation to comply as well as for the outcome evaluation, motivation to comply and perceived power.

As expected, farmers with a positive intention more strongly believe in the positive outcomes of the use of cattle manure, see higher mean values of farmers with a positive intention compared to farmers with a negative intention in Table 9. In addition, farmers with a positive intention value the outcome evaluation of 'increased yield' more that farmers with a negative intention.

Farmers with a positive intention felt more stimulated by most referents and were also more motivated to comply by these referents than farmers with a negative intension (Table 9). But, most

referents were considered barriers. Only neighbours were drivers and found more of a driver for farmers with a positive intention than farmers with a negative intention.

Farmers with a positive intention and non-adopters share many beliefs on control factors, such as the difficult transport, that the product is often not properly packed, that the benefits are not clear, that it is too costly to transport, that it is often too heavy, and that handling and applying is too difficult (compare control factors non-adopters Table 8 with positive intenders Table 9). Both groups have lower values for many control factors than their counterpart farmer groups, farmers with a positive intention compared to negative intention and adopters compared to non-adopters. Lower values for control factors indicates that farmers feel more in control, that is, are less bothered by these control factors than farmers with a higher values.

Table 9 *Summarised results for Belief strength and Outcome evaluation, Normative belief and Motivation to comply, Control belief and Perceived power of farmers with a positive intention (PI, n= 241) and a negative intention (NI, n=81) on the use of cattle manure. (Yellow indicates significant higher at the 5% level).*

	Belief strength				Outcome evaluation			
	PI		NI		PI		NI	
Outcome	Mean	std	Mean	std	Mean	std	Mean	std
Cow manure increases my crop yields	5.32	1.07	4.90	1.27	6.46	0.55	6.25	0.56
Soil cultivation is easier when using cow manure	4.88	1.39	4.22	1.45	6.16	0.68	6.10	0.66
Cow manure is easy to handle and apply	3.35	1.58	2.65	1.34	6.20	0.67	6.30	0.66
Cow manure improves the soil fertility of my fields	5.44	1.02	4.83	1.37	6.43	0.59	6.28	0.60
Cow manure increases yields more than chicken manure	4.98	1.23	3.84	1.50	6.46	0.55	6.25	0.56
Cow manure is easier to use than chicken manure	2.69	1.24	2.14	0.93	6.20	0.67	6.30	0.66
Cow manure is cold (not hot) and does not burn my crops	5.18	1.12	4.77	1.21	6.76	0.71	6.67	0.67
	Normative belief				Motivation to comply			
	PI		NI		PI		NI	
Referent	Mean	std	Mean	std	Mean	std	Mean	std
The use of cow manure is positively discussed in group meetings with other farmers	3.94	1.69	3.41	1.69	5.42	1.09	5.51	1.10
Radio and tv are positive on the use of cow manure	1.78	1.20	1.33	0.71	3.05	1.68	2.27	1.57
Demonstrations from research show that cow manure is beneficial for my crop	2.64	1.54	2.04	1.37	5.01	1.30	4.49	1.37
Neighbours are positive on the use of cow manure	4.70	1.40	4.27	1.79	5.32	1.12	5.22	1.08
	Control belief				Perceived power			
	PI		NI		PI		NI	
Control factor	Mean	std	Mean	std	Mean	std	Mean	std
Transporting cow manure is too difficult	5.96	1.12	6.43	0.81	2.04	0.94	1.62	0.64
Cow manure is often not properly packed	5.88	1.21	6.33	1.01	2.28	0.95	2.33	1.11
I use my own chicken manure	1.28	0.59	1.27	0.82	3.11	1.54	4.36	1.64
The benefits of using cow manure are not clear to me	3.50	1.78	4.44	1.84	3.18	1.73	3.05	1.36
Cow manure is often too wet	5.86	1.15	6.25	0.94	2.04	0.84	2.37	1.44
Transporting cow manure is too costly	5.90	1.22	6.47	0.79	2.21	1.05	2.37	1.35
Cow manure is often to heavy	6.02	0.92	6.49	0.63	2.39	1.05	2.69	1.35
Handling and applying cow manure is too difficult	5.72	1.27	6.37	0.87	2.25	0.94	2.43	1.29

3.3.3 Evaluation of farmers perceptions on the use of manure

Main drivers identified for the use of chicken manure are interesting to compare with drivers for the use of cattle manure. Where price of transport, easy to obtain the product and all time availability, all relate to an easy and affordable delivery system, the dominant drivers for the use of chicken manure, the dominant drivers for the use of cattle manure are agronomic related, that is no damage to crops when properly processed (fermented), increased crop yield and improved soil fertility. An easy and affordable delivery system for cattle manure is not yet established and thus perceived more of a barrier at the moment but can potentially become a large and valuable driver.

The preference of farmers towards "composted/fermented/cold,…" manure products in contrast to "fresh, hot,…" manure products is strongly related to the use/application method of these products and subsequent effects (see par. 2.2.3).
Seeds and plantlets are likely to suffer when the root system comes in direct contact with large amounts of the applied fertilisers (organic and chemical), the seeds or plantlets may "burn" so to speak and the current application method. This risk increases when fresh manure products are used as a top layer due to higher salt content of the products with increased salt concentrations in the rooting environment and crop damage (Mathers & Stewart 1974). Farmers aim to minimize the risks on burning by using ripened, composted (old, cold etc.) manure products.
The application of more liquid, fresh/unfermented/raw and or non-composted/ripened manure products is quite a challenge in the above described system and definitely not envisioned by the farmers: the drivers for the use of chicken manure focus on 'an easy and affordable delivery system'. The application of fresh, wet manure products (including cattle) however, is technically not very risky in terms of crop damage when broadcasted and incorporated before planting. This system is in use in Western Europe for a long time, supported by the right machinery to ease the work. To use fresh, wet manure products as a mulch will definitely damage crops comparable to the farmers experiences. In Western Europe precision agriculture is used to prevent this direct contact between fresh manure products and seeds, just to avoid damage by high salt contents (Pronk *et al.* 2013).

Processing the cattle manure into a fully ripened, 'cold' compost may be costly and thus increase the price of the compost (Sefeedpari *et al.* 2020). Also storing cattle manure for a longer time requires more space in the barn, which is often lacking. In certain cases a fully ripened cattle compost might not be needed: requirements on the quality of the manure product and the price should be discussed among the dairy farmer and the vegetable farmer. Besides improving the supply chain of cattle manure products, also the application strategy/method of farmers who use cattle manure products can be improved, in order to reduce the risks of burning their crops. Of course, this is only possible when other issues such as handling and transportation have been solved.

From the results of the interviews it shows clearly that the use of cattle manure is within view of farmers, but that they have doubts about the quality of the product and have serious problems with the transport of the product. To solve quality issues, farmers may need to work with suppliers on their requirements and explore technical options. It may also be possible to work on the application methods of farmers to avoid the expected negative effects of the application of fresh cattle manure. The sound application of fresh cattle manure provides valuable nutrients to the crop and will most likely increases production. Best options might be to enhance the use of cattle manure by farmers in the vicinity of dairy farms, as transportation of cattle manure may be cumbersome and costly.

The findings of this study and some of the above mentioned suggestions should be discussed in focus group discussions with small-scale vegetable farmers and dairy farmers. Traditionally, the focus group discussions are performed to have feedback on the findings and to build on them to break down barriers to promote adoption. The long list of manure products used by farmers (Table 3) shows that farmers are experimenting with different types of cattle manure products (e.g. fresh manure, heap manure, compost, vermi-compost) and mixtures of chicken manure with cattle manure and/or crop residues. Exploring the benefits of these products could be valuable for further development the cattle manure supply chain.

4 Conclusions

4.1 Respondents characteristics

The average age of small-scale vegetable (horticultural) farmers in Lembang Sub-District was 45 years old and only a few respondents were female. All respondents were in charge of the farming decisions, so the right population for the survey was selected. About half of the area cultivated was owned by the respondents and almost all farmers were a member of some kind of farmer organisation.

4.2 Farm characteristics

The area cultivated by farmers was small, approximately 3,000 m^2 per farmer, and intensively used. The land was mostly used for the production of horticultural crops and owned for 45% by the farmers. Two cropping systems were practiced, mono cropping and inter or multiple cropping. The majority of the farmers, 61%, practiced inter or multiple cropping. In inter/multiple cropping systems up to three crops were cultivated simultaneously. In total, 25 different horticultural crops were cultivated. The most frequently cultivated crops in the mono cropping system were Broccoli, cultivated by 39 farmers, followed by lettuce, 21 farmers, tomato, 14 farmers, and Chinese cabbage and string beans, both 9 farmers. In inter/multiple cropping systems lettuce was grown by 73 farmers, followed by Broccoli, 68 farmers, tomato, 65 farmers and Cayenne pepper, 61 farmers. The largest area cultivated in this study was with Romain Lettuce, almost 21,000 m^2, that is 21 ha, by one farmer in a mono cropping system. The second, third and fourth largest areas in the mono cropping system were corn, 3,500 m^2, cassava, 2,800 m^2 and string beans, 2,403 m^2. The largest average area cultivated by an individual farmer in inter/multiple cropping systems was with coffee, 7,000 m^2, followed by asparagus, 6,160 m^2, mustard green 3,698 m^2 and eggplant 3,469 m^2.

Chemical fertiliser use was on average 81 and 154 kg N/ha in the mono and inter/multiple cropping systems respectively. Comparable amounts of P_2O_5 and K_2O were applied. These application rates are in agreement with application rates found in other studies (Voort *et al.* 2018). Additionally, 86% of the farmers applied organic fertilisers. A large range of manure products was used (20), both solid and liquid products. The average application rate of manure was 13 tons/ha in the mono cropping system and 17.5 tons/ha in the inter or multiple cropping system which is lower than the recommended dose for chicken manure products (Moekasan *et al.* 2015) but advisable when more than once per year manure products are used and mineralisation and leaching of nutrients from manure products are considered. Farmers in Indonesia use manure products for general soil fertility improvement and hardly consider the fertiliser value of these products. Frequent manure applications increases mineral nutrient availability and when the chemical fertiliser applications are not corrected for this, increased losses may occur. The organic fertiliser most applied was 'Chicken manure with rice husks postal', used by 74 and 102 farmers in the mono and inter/multiple cropping system respectively. This manure product was also applied at the highest dose, 20 tons/ha, in the mono cropping system where almost 40 tons/ha of the product 'Cattle solid manure from heap without plant materials' was the highest dose applied in inter/multiple cropping systems (2 farmers only). The total costs for organic fertiliser products varied between 0.03 to 7 million IDR/ha for the cultivation in the mono cropping system to 0.3 to almost 18 million IDR/ha in inter/multiple cropping systems. The costs for the most frequently applied product was almost 8 and 9.4 million IDR/ha in the mono and inter/multiple cropping system respectively.

The grouping of organic fertiliser products into 'Cattle', 'Cattle + Chicken', 'Chicken' and 'Other' and analysing the application rates to specific crops, showed that some crops are favoured over others with high organic fertiliser application rates. Romaine lettuce is heavily fertilised with chicken manure

at considerable costs in the mono cropping system, even higher than the recommendations for organic fertiliser applications in general for vegetables and even more than for lettuce. In inter/multiple cropping systems Broccoli and lettuce receive organic fertilisers at high rates as well, where lettuce is fertilised with Chicken at rates above 30 ton/ha which is slightly higher than the maximum recommended dose of 30 tons/ha (Moekasan *et al.* 2015).

The farms of the respondents are indeed characterised as small-scale vegetable farmers with a high demand for organic fertilisers. For some crops organic fertiliser applications are above recommendations. Also, chemical fertiliser applications are not adjusted to mineralisation from organic amendments, which is likely to facilitate leaching of nutrients due to over application of fertilisers.

4.3 Farmers perceptions on the use of manure

Of the respondents 290 used chicken manure and 41 used cattle manure. The survey results of both management practices showed sufficiently high consistency scores and intention scores, which allowed the results to be analysed according to the theory of planned behaviour. With this theory we evaluated the perceptions of farmers on the use chicken and cattle manure with respect to farmers beliefs, control power and referents (people in farmers' surroundings) on farmer's behaviour. For the use of chicken manure we concentrated on drivers where for the use of cattle manure we evaluated both drivers and barriers of respondents toward the practice.

Chicken manure
With respect to the perceptions of farmers on the use of chicken manure this study shows that farmers have a large positive attitude towards the use of chicken manure although farmers believe that people in their social surroundings are less positive on the use of chicken manure. Farmers only feel stimulated on the use of chicken manure by their neighbours. The dominant drivers for farmers to use chicken manure are related to the product being 'cheap to transport', 'easy to obtain' and 'easy to handle and apply'. Those drivers relate to an easy and affordable delivery system as part of the supply chain and that it is easy to use. These are all highly appreciated by farmers. Other important drivers are e.g. easy transport, followed by agronomic drivers such as increases in crop yields and easier soil cultivation.

Summary on the main drivers for the use of chicken manure:
- Low transportation costs of chicken manure,
- Chicken manure is easy to obtain,
- Chicken manure is easy to handle and apply,
- Neighbours are positive on the use of chicken manure.

Cattle manure
With respect to the perceptions of farmers on the use of cattle manure this study shows that farmers have a positive attitude towards the use of cattle manure although farmers believe that people in their social surroundings are less positive on the use of cattle manure. Farmers only feel stimulated on the use of cattle manure by their neighbours. The dominant drivers for farmers to use cattle manure are related to the product being 'cold and thus not burning their crops', improving their soils, both fertility and cultivation, and increasing 'crop yield', being 'available any time', 'easy to obtain, to handle, to apply'.
Those drivers relate to valuable agronomic qualities for crop production, an easy delivery system as part of the supply chain and that it is easy to use. These are all highly appreciated by farmers.

Summary on the main drivers for the use of cattle manure:
- Cattle manure increases soil fertility and soil cultivation,
- Cattle manure increases crop yield, even more than chicken manure,
- Cattle manure is available any time, easy to obtain, to handle, to apply,
- Neighbours are positive on the use of cattle manure.

This study also shows that farmers have serious objections towards the use of cattle manure. The main identified barriers for the use of cattle manure relate to product quality and the supply chain not being well developed for their needs. The product is considered not to have the right composition which may therefore harm ('burn') their crop and is difficult to transport, handle and too expensive.

Summary on the main barriers for the use of cattle manure:
- Fresh, unfermented cattle manure damages my crop,
- Transport of cattle manure is too difficult,
- Cattle manure is often too wet,
- Transport of cattle manure is too costly.

There are more farmers with a positive intention (241) than farmers who actually use cattle manure (41). So, there seems to be a large potential for farmers changing to the use of cattle manure, about 200 farmers in this survey.

All farmer groups (adopters, non-adopters, farmers with a negative intention and farmers with a positive intention) share the main drivers for the use of cattle manure and beliefs on the social surroundings. Differences between farmer groups are found for the main barriers and summarised below.

Summarised differences between farmers on main barriers for the use of cattle manure:
- Negative attitude of the social surrounding on the use of cattle manure. This believe is shared by all farmers (adopters, non-adopters, farmers with a positive and negative intention) except for their neighbours, who they believe to be positive on cattle manure use. To promote adoption it would help if farmers believe that their referents are positive on the use of cattle manure.
- Damage to the crop by fresh/unfermented cattle manure. This belief is shared by all famers (adopters, non-adopters, farmers with a positive and negative intention) and must be solved to facilitate adoption.
- Transportation difficulties (too difficult, too expensive). Adopters stronger believe in transportation difficulties when using cattle manure than non-adopters. However, adopters seem to handle this better because they use cattle manure and feel more in control of this barrier. Evaluating how adopters handle transportation and share that information with farmers with a positive intention is likely to support adoption.
- Product composition (too wet, too heavy, not properly bagged). Adopters stronger believe in bottlenecks related to product composition than non-adopters. However, adopters find a way to coop with these bottlenecks as they use cattle manure. Farmers with a positive intention are less bothered by these bottlenecks than farmers with a negative intention. Evaluating how adopters coop with them and share that information with farmers with a positive intention is likely to support adoption.
- Handling and applying cattle manure. Adopters stronger believe in difficulties with handling and applying cattle manure than non-adopters. However, adopters seem to find way to handle and apply cattle manure nevertheless. Evaluating how adopters handle and apply cattle manure and share that information with farmers with a positive intention is likely to support adoption.

To stimulate farmers with a positive intention on the use cattle manure to adopt the practice, it is recommended to:
- Enhance a positive attitude towards using cattle manure of people in the social surroundings of farmers (referents),
- Organize demonstrations and focus group discussions on using cattle manure with neighbouring farmers with a positive intention,
- Improve the supply chain for cattle manure products (quality, transportation, - costs).

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Annex 1 Number of selected farms in the different villages

Village	Nr.
Cibodas	30
Cibogo	22
Cikahuripan	15
Cikidang	42
Cikole	35
Gudang Kahuripan	5
Jayagiri	12
Kayuambon	15
Langensari	23
Lembang	15
Mekarwangi	14
Pagerwangi	15
Sukajaya	4
Suntenjaya	48
Wangunharja	17
Wangunsari	10

Annex 2 Application rates [kg product/ha] of manure products in different crops

Manure Type	Asparagus	Beef Tomato	Broccoli	Cabbage	Cassava	Cauli-flower	Celery	Chinese cabbage	Coriander	Corn	Cucumber	Eggplant	Golden berry
Biogreen													
Cattle compost after mixing and turning				12,245			10,714						
Cattle manure													
Cattle manure + chicken manure + rice husks postal	17,866		27,143			35,724		10,714				1,071	
Cattle manure + compost													
Cattle solid manure from a heap + plant materials			9,490			10,714							14,286
Cattle solid manure from a heap - plant materials			4,286										
Cattle urine													
Chicken manure from rooster			4,632	5,510			3,214						1,286
Chicken manure - rice husks batere			6,449			4,286			5,714			14,732	
Chicken manure + rice husks postal	16,071		19,348	9,853	10,714	19,984	20,483	22,135					26,786
Goat manure			17,500	10,714									
Goat manure liquid				143									
Goat manure + rabbit urine			295										
Horse manure													
Liquid organic fertiliser		6,122											
Rabbit manure													
Rabbit urine	268		190										
Subur Ijo organic fertiliser			46			24		71		23	57	6	
Vermi-compost			1,929										16,071

Manure Type	Horenzo Japanese spinach	Lettuce	Lollo Rossa	Mustard Green	Pepper, Cayenne	Pepper, curly hot	Pepper, hot	Pepper, Jalapeno	Radish	Romaine Lettuce	Straw-berry	String bean	Tomato	Zucchini
Biogreen													36	
Cattle compost after mixing and turning	257	10,714										814		
Cattle manure		5,000												
Cattle manure + chicken manure +rice husks postal		9,531			6,429					33,214			5,357	19,643
Cattle manure + compost	14,271													
Cattle solid manure from a heap +plant materials		5,595			14,881									3,214
Cattle solid manure from a heap -plant materials		12,857		2,143			57,143							
Cattle urine		179												
Chicken manure from rooster		3,767		3,214	2,834								4,307	1,964
Chicken manure - rice husks batere		2,844			3,721		7,143			1,071		3,349	8,080	
Chicken manure + rice husks postal	13,936	30,271	12,857	21,714	25,643		23,776	21,429		22,038	42,857	26,321	32,062	
Goat manure	4,725	4,315	12,857	35,714	9,198							5,764	10,714	
Goat manure liquid														
Goat manure + rabbit urine														
Horse manure		4,286												
Liquid organic fertiliser	429				7					3				
Rabbit manure		11,905												
Rabbit urine														
Subur Ijo organic fertiliser					19							100	54	
Vermi-compost	4,297	2,513		2,143			2,143			952		1,429	8,143	

Annex 3 Costs [10^6 IDR/ha] of manure products in different crops

Manure Type	Asparagus	Beef Tomato	Broccoli	Cabbage	Cassava	Cauli-flower	Celery	Chinese cabbage	Coriander	Corn	Cucumber	Eggplant	Golden berry
Biogreen													
Cattle compost after mixing and turning				4.08			7.14						
Cattle manure													
Cattle manure + chicken manure + rice husks postal			9.55			2.56		3.57				0.30	
Cattle manure + compost													
Cattle solid manure from a heap + plant materials			5.14										2.38
Cattle solid manure from a heap – plant materials			0.71										
Cattle urine													
Chicken manure from rooster			3.55	4.36			2.68						1.07
Chicken manure - rice husks batere			3.50			3.57			4.57			8.84	
Chicken manure + rice husks postal	5.89		6.59	3.48	7.14	6.70	7.18	8.02					8.93
Goat manure			5.71										
Goat manure liquid													
Goat manure + rabbit urine			0.27										
Horse manure													
Liquid organic fertiliser		30.61											
Rabbit manure													
Rabbit urine			0.19										
Subur Ijo organic fertiliser			2.76			1.65		4.64		1.71	4.29	0.12	
Vermi-compost			1.61										13.39

Manure Type	Horenzo Japanese spinach	Lettuce	Lollo Rossa	Mustard Green	Pepper, Cayenne	Pepper, curly hot	Pepper, hot	Pepper, Jalapeno	Radish	Romaine Lettuce	Straw-berry	String bean	Tomato	Zucchini
Biogreen													1.79	
Cattle compost after mixing and turning	0.13													
Cattle manure		3.33												
Cattle manure + chicken manure + rice husks postal		1.99			1.07					12.32			1.79	6.55
Cattle manure + compost	4.76													
Cattle solid manure from a heap + plant materials		0.79												0.80
Cattle solid manure from a heap - plant materials		7.14		0.36										
Cattle urine		0.89												
Chicken manure from rooster		3.09		2.68	2.46								3.55	1.79
Chicken manure - rice husks batere		2.16			2.48		4.05			0.71		2.44	5.16	
Chicken manure + rice husks postal	4.20	10.19	5.14	7.30	9.02		9.37	12.14		7.05	14.29	7.80	11.08	
Goat manure	1.22	1.03		17.86	4.76							1.79	3.37	
Goat manure liquid														
Goat manure + rabbit urine														
Horse manure		0.71												
Liquid organic fertiliser	5.14									0.03				
Rabbit manure														
Rabbit urine														
Subur Ijo organic fertiliser					0.25							7.52	3.70	
Vermi-compost	3.18	2.00		1.79			1.79			0.79		1.19	7.33	

Annex 4 Survey results on 1: behavioural belief strength, outcome evaluation and attitude, 2: normative belief, motivation to comply and subjective norm and 3: control strength, control power and perceived behavioural control for the use of chicken manure

OUTCOME	BEHAVIOURAL BELIEF STRENGTH					OUTCOME EVALUATION					ATTITUDE			
	CODE	n	MEANS	STD	MEDIAN	CODE	n	MEANS	STD	MEDIAN	n	MEANS	STD	MEDIAN
Chicken manure increases my crop yields	chick_os_1	322	5.54	1.15	6	chick_ov_1	322	6.40	0.56	6	322	13.35	4.32	12
Soil cultivation is easier when using chicken manure	chick_os_2	322	5.59	1.15	6	chick_ov_2	322	6.14	0.67	6	322	12.02	4.65	12
Chicken manure is easy to use	chick_os_3	322	6.30	0.67	6	chick_ov_3	322	6.23	0.67	6	322	14.11	4.63	14
Chicken manure improves the soil fertility of my fields	chick_os_4	322	5.43	1.18	6	chick_ov_4	322	6.39	0.59	6	322	12.93	4.21	12
Fresh/unfermented chicken manure damages my crops	chick_os_5	322	5.86	1.44	6	chick_ov_5	322	1.34	0.86	1	322	-15.62	6.61	-18
Chicken manure increases yields more than cattle manure	chick_os_7	322	4.23	1.51	4	chick_ov_7	322	6.40	0.56	6	322	10.13	4.42	9
Chicken manure is easier to use than cattle manure	chick_os_8	322	6.24	0.85	6	chick_ov_8	322	6.23	0.67	6	322	13.94	4.72	14
Transport of chicken manure is easy	chick_os_9	322	6.35	0.74	6	chick_ov_9	322	6.13	0.82	6	322	13.69	5.67	14
Transporting chicken manure is cheap	chick_os_10	322	5.98	1.24	6	chick_ov_10	322	6.74	0.70	7	322	16.50	5.29	18
Chicken manure is easy to obtain	chick_os_11	322	6.45	0.62	7	chick_ov_11	322	6.34	0.73	6	322	15.17	5.09	14
Chicken manure is available anytime	chick_os_12	322	6.47	0.67	7	chick_ov_12	322	6.40	0.56	6	322	13.35	4.32	12
									OVERALL ATTITUDE			122.05	29.04	123

REFERENT	NORMATIVE BELIEF					MOTIVATION TO COMPLY					SUBJECTIVE NORM			
	CODE	N	MEANS	STD	MEDIAN	CODE	N	MEANS	STD	MEDIAN	N	MEANS	STD	MEDIAN
Extension agents advise the use of chicken manure	chick_rs_1	322	3.40	1.63	4	chick_rm_1	322	5.27	1.10	6	322	-2.61	8.72	0
The use of chicken manure is positively discussed in group meetings with other farmers	chick_rs_2	322	4.06	1.69	4	chick_rm_2	322	5.44	1.09	6	322	0.59	9.39	0
Brochures promote the use of chicken manure	chick_rs_3	322	1.57	0.91	1	chick_rm_3	322	2.98	1.65	3	322	-6.83	5.30	-6
Agrishops promote the use of chicken manure	chick_rs_4	322	1.67	1.13	1	chick_rm_4	322	3.54	1.85	3	322	-7.69	6.54	-6
Radio and tv are positive on the use of chicken manure	chick_rs_5	322	1.58	0.96	1	chick_rm_5	322	2.85	1.69	3	322	-6.38	5.03	-6
Demonstrations from research show that chicken manure is beneficial for my crop	chick_rs_6	322	2.70	1.66	2	chick_rm_6	322	4.88	1.33	5	322	-5.91	8.51	-6
Pest observers are positive on the use of chicken manure	chick_rs_7	322	3.06	1.59	3	chick_rm_7	322	4.72	1.33	5	322	-4.12	8.10	-3
Neighbours are positive on the use of chicken manure	chick_rs_8	322	5.34	1.30	6	chick_rm_8	322	5.30	1.11	6	322	7.50	6.87	10
The positive effects of the use of chicken manure is emphasized by promotion/salesman	chick_rs_9	322	1.62	0.96	1	chick_rm_9	322	2.78	1.67	2	322	-6.14	4.96	-6
								OVERALL SUBJECTIVE NORM				-31.6	40.4	-25

CONTROL FACTOR	CONTROL STRENGTH					CONTROL POWER					PERCEIVED BEHAVIORAL CONTROL			
	CODE	N	MEANS	STD	MEDIAN	CODE	N	MEANS	STD	MEDIAN	N	MEANS	STD	MEDIAN
The packaging of chicken manure is too heavy to transport to my field	chick_cs_1	322	2.38	1.19	2	chick_cp_1	322	1.93	0.90	2	322	-4.81	3.14	-4
I am unfamiliar with the use of chicken manure	chick_cs_3	322	1.95	1.13	2	chick_cp_3	322	2.46	1.39	2	322	-3.00	3.35	-3
Chicken manure is too expensive	chick_cs_4	322	3.16	1.49	3	chick_cp_4	322	2.03	1.10	2	322	-6.18	4.23	-6
I use my own cattle manure	chick_cs_5	322	1.88	1.71	1	chick_cp_5	322	2.03	1.12	2	322	-3.49	4.17	-3
The benefits of using chicken manure are not clear to me	chick_cs_6	322	2.69	1.55	2	chick_cp_6	322	3.08	1.90	2	322	-2.20	5.76	-3
Chicken manure is not available in my neighbourhood	chick_cs_7	322	3.54	1.91	3	chick_cp_7	322	1.86	0.79	2	322	-7.53	5.24	-6
Chicken manure is often too wet	chick_cs_8	322	2.16	0.97	2	chick_cp_8	322	1.94	1.10	2	322	-4.46	3.23	-4
								OVERALL PERCEIVED BEHAVIROURAL CONTROL				-31.67	14.72	-32

Annex 5 Survey results on 1: behavioural belief strength, outcome evaluation and attitude, 2: normative belief, motivation to comply and subjective norm and 3: control strength, control power and perceived behavioural control for the use of cattle manure

OUTCOME	BEHAVIOURAL BELIEF STRENGTH					OUTCOME EVALUATION					ATTITUDE			
	CODE	N	MEANS	STD	MEDIAN	CODE	N	MEANS	STD	MEDIAN	N	MEANS	STD	MEDIAN
Cattle manure increases my crop yields	cattle_os_1	322	5.22	1.14	6	cattle_ov_1	322	6.40	0.56	6	322	12.59	4.09	12
Soil cultivation is easier when using cattle manure	cattle_os_2	322	4.71	1.43	5	cattle_ov_2	322	6.14	0.67	6	322	10.18	4.71	10
Cattle manure is easy to use	cattle_os_3	322	3.17	1.55	3	cattle_ov_3	322	6.23	0.67	6	322	7.05	4.14	6
Cattle manure improves the soil fertility of my fields	cattle_os_4	322	5.29	1.14	5	cattle_ov_4	322	6.39	0.59	6	322	12.71	4.29	12
Fresh/unfermented cattle manure damages my crops	cattle_os_5	322	5.55	1.24	6	cattle_ov_5	322	1.34	0.86	1	322	-14.78	6.21	-15
Cattle manure increases yields more than chicken manure	cattle_os_7	322	4.70	1.40	4.5	cattle_ov_7	322	6.40	0.56	6	322	11.34	4.32	12
Cattle manure is easier to use than chicken manure	cattle_os_8	322	2.55	1.19	2	cattle_ov_8	322	6.23	0.67	6	322	5.68	3.36	6
Cold cattle manure does not damages my crops	cattle_os_10	322	5.07	1.15	5	cattle_ov_9	322	6.74	0.70	7	322	13.96	4.85	15
Cattle manure is easy to obtain	cattle_os_12	322	4.18	1.72	4	cattle_ov_10	322	6.34	0.73	6	322	9.81	5.27	10
Cattle manure is available any time	cattle_os_13	322	4.13	1.82	4	cattle_ov_11	322	6.44	0.69	7	322	10.07	5.54	10
									OVERALL ATTITUDE			78.62	24.75	77

REFERENT	NORMATIVE BELIEF					MOTIVATION TO COMPLY					SUBJECTIVE NORM			
	CODE	N	MEANS	STD	MEDIAN	CODE	N	MEANS	STD	MEDIAN	N	MEANS	STD	MEDIAN
Extension agents advise the use of cattle manure	cattle_rs_1	322	3.61	1.70	4	cattle_rm_1	322	5.27	1.10	6	322	-1.41	9.16	0
The use of cattle manure is positively discussed in group meetings with other farmers	cattle_rs_2	322	3.81	1.70	4	cattle_rm_2	322	5.44	1.09	6	322	-0.82	9.36	0
Brochures promote the use of cattle manure	cattle_rs_3	322	1.58	1.00	1	cattle_rm_3	322	2.98	1.65	3	322	-6.85	5.37	-6
Agrishops promote the use of cattle manure	cattle_rs_4	322	1.48	0.88	1	cattle_rm_4	322	3.54	1.85	3	322	-8.59	5.99	-6
Radio and tv are positive on the use of cattle manure	cattle_rs_5	322	1.67	1.11	1	cattle_rm_5	322	2.85	1.69	3	322	-6.07	5.34	-6
Demonstrations from research show that cattle manure is beneficial for my crop	cattle_rs_6	322	2.49	1.52	2	cattle_rm_6	322	4.88	1.33	5	322	-7.02	7.93	-9
Pest observers are positive on the use of cattle manure	cattle_rs_7	322	2.97	1.59	3	cattle_rm_7	322	4.72	1.33	5	322	-4.48	8.00	-4
Neighbours are positive on the use of cattle manure	cattle_rs_8	322	4.59	1.51	5	cattle_rm_8	322	5.30	1.11	6	322	3.49	8.16	5
The positive effects of the use of cattle manure is emphasized by promotion/salesman	cattle_rs_9	322	1.48	0.81	1	cattle_rm_9	322	2.78	1.67	2	322	-6.73	4.92	-6
								OVERALL SUBJECTIVE NORM				-38.5	41.5	-27.5

CONTROL FACTOR	CONTROL STRENGTH					CONTROL POWER					PERCEIVED BEHAVIORAL CONTROL			
	CODE	N	MEANS	STD	MEDIAN	CODE	N	MEANS	STD	MEDIAN	N	MEANS	STD	MEDIAN
Transporting cattle manure is too difficult	cattle_cs_1	322	6.08	1.07	6	cattle_cp_1	322	1.93	0.90	2	322	-12.84	6.36	-12
Cattle manure is often not properly packed	cattle_cs_2	322	6.00	1.18	6	cattle_cp_2	322	2.30	0.99	2	322	-10.36	6.75	-12
I am unfamiliar with the use of cattle manure	cattle_cs_3	322	4.52	1.90	5	cattle_cp_3	322	2.46	1.39	2	322	-7.52	7.32	-8
Cattle manure is too expensive	cattle_cs_4	322	3.91	1.76	4	cattle_cp_4	322	2.40	1.16	2	322	-6.41	6.07	-5
I use my own chicken manure	cattle_cs_5	322	1.28	0.66	1	cattle_cp_5	322	3.43	1.65	3	322	-0.62	2.32	-1
The benefits of using cattle manure are not clear to me	cattle_cs_6	322	3.74	1.84	4	cattle_cp_6	322	3.15	1.65	2	322	-4.08	6.73	-4
Cattle manure is not available in my neighbourhood	cattle_cs_7	322	3.92	2.04	4	cattle_cp_7	322	2.64	1.38	2	322	-5.63	6.84	-4
Cattle manure is often too wet	cattle_cs_8	322	5.96	1.11	6	cattle_cp_8	322	2.12	1.03	2	322	-11.30	7.01	-12
The transport of cattle manure is too costly	cattle_cs_9	322	6.04	1.15	6	cattle_cp_9	322	2.25	1.13	2	322	-10.84	7.82	-12
Cattle manure is often too heavy	cattle_cs_10	322	6.14	0.88	6	cattle_cp_10	322	2.47	1.14	2	322	-9.64	7.67	-12
Handling and applying cattle manure is too difficult	cattle_cs_11	322	5.88	1.21	6	cattle_cp_11	322	2.30	1.04	2	322	-10.08	6.96	-12
						OVERALL PERCEIVED BEHAVIROURAL CONTROL						-89.32	40.05	-88

Annex 6 Survey results on the differences in 1: behavioural belief strength and outcome evaluation, 2: normative belief and motivation to comply 3: control strength and control power for the use of cattle manure between adopters and non-adopters

OUTCOME	BEHAVIOURAL BELIEF STRENGTH						OUTCOME EVALUATION					
	Adopters (41)		Non-adopters (281)		CODE	P-value	Adopters (41)		Non-adopters (281)		CODE	P-value
	mean	std	mean	std			mean	std	mean	std		
Cattle manure increases my crop yields	5.16	1.14	5.61	1.07	cattle_os_1	0.0180	6.38	0.57	6.54	0.50	cattle_ov_1	0.1055
Soil cultivation is easier when using cattle manure	4.65	1.41	5.10	1.56	cattle_os_2	0.0643	6.12	0.68	6.32	0.61	cattle_ov_2	0.0760
Cattle manure is easy to handle and apply	3.05	1.50	4.05	1.61	cattle_os_3	0.0001	6.22	0.67	6.24	0.66	cattle_ov_3	0.8599
Cattle manure improves the soil fertility of my fields	5.25	1.14	5.54	1.12	cattle_os_4	0.1329	6.37	0.60	6.54	0.55	cattle_ov_4	0.1004
Fresh/unfermented cattle manure damages my crops	5.56	1.23	5.49	1.29	cattle_os_5	0.7324	1.31	0.79	1.51	1.23	cattle_ov_5	0.1577
Cattle manure increases yields more than chicken manure	4.68	1.41	4.83	1.28	cattle_os_7	0.5128	6.38	0.57	6.54	0.50	cattle_ov_7	0.1055
Cattle manure is easier to use than chicken manure	2.46	1.16	3.20	1.21	cattle_os_8	0.0002	6.22	0.67	6.24	0.66	cattle_ov_8	0.8599
Cattle manure is cold (not hot) and does not burn my crops	5.05	1.16	5.27	1.10	cattle_os_9	0.2508	6.75	0.68	6.68	0.85	cattle_ov_9	0.5838
Cattle manure is easy to obtain	4.07	1.73	4.95	1.50	cattle_os_10	0.0021	6.35	0.71	6.32	0.91	cattle_ov_10	0.8189
Cattle manure is available anytime	4.02	1.82	4.90	1.58	cattle_os_11	0.0034	6.44	0.65	6.44	0.90	cattle_ov_11	0.9597

REFERENT	NORMATIVE BELIEF						MOTIVATION TO COMPLY					
	Adopters (41)		Non-adopters (281)		CODE	P-value	Adopters (41)		Non-adopters (281)		CODE	P-value
	mean	std	mean	std			mean	std	mean	std		
Extension agents advise the use of cattle manure	3.60	1.73	3.68	1.52	cattle_rs_1	0.7658	5.31	1.09	5.05	1.12	cattle_rm_1	0.1608
The use of cattle manure is positively discussed in group meetings with other farmers	3.74	1.69	4.24	1.73	cattle_rs_2	0.0791	5.46	1.11	5.34	0.99	cattle_rm_2	0.5207
Brochures promote the use of cattle manure	1.55	1.00	1.78	1.01	cattle_rs_3	0.1645	2.97	1.69	3.00	1.34	cattle_rm_3	0.9178
Agrishops promote the use of cattle manure	1.46	0.88	1.59	0.92	cattle_rs_4	0.4067	3.51	1.88	3.78	1.67	cattle_rm_4	0.3748
Radio and tv are positive on the use of cattle manure	1.62	1.09	1.98	1.19	cattle_rs_5	0.0571	2.81	1.71	3.12	1.54	cattle_rm_5	0.2713
Demonstrations from research show that cattle manure is beneficial for my crop	2.39	1.50	3.17	1.50	cattle_rs_6	0.0020	4.85	1.36	5.07	1.17	cattle_rm_6	0.3268
Pest observers are positive on the use of cattle manure	2.95	1.59	3.10	1.56	cattle_rs_7	0.5886	4.74	1.33	4.59	1.38	cattle_rm_7	0.4781
Neighbours are positive on the use of cattle manure	4.51	1.56	5.20	1.01	cattle_rs_8	0.0062	5.29	1.14	5.32	0.88	cattle_rm_8	0.8916
The positive effects of the use of cattle manure is emphasized by promotion/salesman	1.44	0.76	1.73	1.07	cattle_rs_9	0.0347	2.81	1.70	2.54	1.43	cattle_rm_9	0.3201

CONTROL FACTOR	CONTROL STRENGTH						CONTROL POWER					
	Adopters(41)		Non-adopters (281)		CODE	P-value	Adopters(41)		Non-adopters (281)		CODE	P-value
	mean	sd	mean	sd			mean	sd	mean	sd		
Transporting cattle manure is too difficult	6.15	0.97	5.56	1.50	cattle_cs_1	0.0008	1.84	0.78	2.59	1.30	cattle_cp_1	0.0000
Cattle manure is often not properly packed	6.09	1.12	5.37	1.39	cattle_cs_2	0.0002	2.31	1.02	2.22	0.72	cattle_cp_2	0.6021
I am unfamiliar with the use of cattle manure	4.80	1.79	2.59	1.48	cattle_cs_3	0.0000	2.46	1.42	2.44	1.16	cattle_cp_3	0.9315
Cattle manure is too expensive	4.04	1.77	3.05	1.48	cattle_cs_4	0.0007	2.44	1.19	2.12	0.90	cattle_cp_4	0.1010
I use my own chicken manure	1.26	0.57	1.39	1.07	cattle_cs_5	0.2491	3.58	1.64	2.39	1.38	cattle_cp_5	0.0000
The benefits of using cattle manure are not clear to me	3.88	1.83	2.76	1.58	cattle_cs_6	0.0002	3.11	1.63	3.44	1.75	cattle_cp_6	0.2281
Cattle manure is not available in my neighbourhood	4.12	2.03	2.59	1.56	cattle_cs_7	0.0000	2.72	1.42	2.10	0.80	cattle_cp_7	0.0064
Cattle manure is often too wet	5.99	1.10	5.73	1.18	cattle_cs_8	0.1664	2.14	1.06	1.98	0.82	cattle_cp_8	0.3349
The transport of cattle manure is too costly	6.17	1.01	5.20	1.63	cattle_cs_9	0.0000	2.28	1.15	2.02	1.01	cattle_cp_9	0.1757
Cattle manure is often too heavy	6.20	0.81	5.68	1.17	cattle_cs_10	0.0004	2.47	1.14	2.44	1.12	cattle_cp_10	0.8574
Handling and applying cattle manure is too difficult	6.00	1.12	5.10	1.53	cattle_cs_11	0.0000	2.30	1.04	2.29	1.08	cattle_cp_11	0.9877

Annex 7 Survey results on the differences in 1: behavioural belief strength and outcome evaluation, 2: normative belief and motivation to comply 3: control strength and control power for the use of cattle manure between respondents with positive versus negative intention

OUTCOME	BEHAVIORAL BELIEF STRENGTH						OUTCOME EVALUATION					
	Positive intention (241)		Negative intention (81)		CODE	P-value	Positive intention (241)		Negative intention (81)		CODE	P-value
	mean	sd	mean	sd			mean	sd	mean	sd		
Cattle manure increases my crop yields	5.32	1.07	4.90	1.27	cattle_os_1	0.0037	6.46	0.55	6.25	0.56	cattle_ov_1	0.0036
Soil cultivation is easier when using cattle manure	4.88	1.39	4.22	1.45	cattle_os_2	0.0003	6.16	0.68	6.10	0.66	cattle_ov_2	0.4964
Cattle manure is easy to use	3.35	1.58	2.65	1.34	cattle_os_3	0.0004	6.20	0.67	6.30	0.66	cattle_ov_3	0.2778
Cattle manure improves the soil fertility of my fields	5.44	1.02	4.83	1.37	cattle_os_4	0.0000	6.43	0.59	6.28	0.60	cattle_ov_4	0.0525
Fresh/unfermented cattle manure damages my crops	5.55	1.16	5.54	1.45	cattle_os_5	0.9567	1.30	0.82	1.44	0.96	cattle_ov_5	0.1861
Cattle manure increases yields more than chicken manure	4.98	1.23	3.84	1.50	cattle_os_7	0.0000	6.46	0.55	6.25	0.56	cattle_ov_7	0.0036
Cattle manure is easier to use than chicken manure	2.69	1.24	2.14	0.93	cattle_os_8	0.0003	6.20	0.67	6.30	0.66	cattle_ov_8	0.2778
Cold cattle manure does not burn my crops	5.18	1.12	4.77	1.21	cattle_os_9	0.0052	6.76	0.71	6.67	0.67	cattle_ov_9	0.2834
Cattle manure is easy to obtain	4.27	1.72	3.93	1.72	cattle_os_10	0.1203	6.36	0.73	6.30	0.73	cattle_ov_10	0.5209
Cattle manure is available any time	4.19	1.79	3.95	1.90	cattle_os_11	0.3037	6.45	0.73	6.43	0.55	cattle_ov_11	0.8561

REFERENT	NORMATIVE BELIEF						MOTIVATION TO COMPLY					
	Positive intention (241)		Negative intention (81)		CODE	P-value	Positive intention (241)		Negative intention (81)		CODE	P-value
	mean	sd	mean	sd			mean	sd	mean	sd		
Extension agents advise the use of cattle manure	3.63	1.67	3.56	1.81	cow_rs_1	0.7463	5.27	1.12	5.28	1.04	cow_rm_1	0.9196
The use of cattle manure is positively discussed in group meetings with other farmers	3.94	1.69	3.41	1.69	cow_rs_2	0.0144	5.42	1.09	5.51	1.10	cow_rm_2	0.5555
Brochures promote the use of cattle manure	1.63	1.02	1.41	0.92	cow_rs_3	0.0763	3.07	1.66	2.69	1.59	cow_rm_3	0.0728
Agrishops promote the use of cattle manure	1.54	0.90	1.30	0.80	cow_rs_4	0.0319	3.63	1.82	3.28	1.93	cow_rm_4	0.1499
Radio and tv are positive on the use of cattle manure	1.78	1.20	1.33	0.71	cow_rs_5	0.0016	3.05	1.68	2.27	1.57	cow_rm_5	0.0003
Demonstrations from research show that cattle manure is beneficial for my crop	2.64	1.54	2.04	1.37	cow_rs_6	0.0020	5.01	1.30	4.49	1.37	cow_rm_6	0.0024
Pest observers are positive on the use of cattle manure	2.98	1.59	2.95	1.59	cow_rs_7	0.8885	4.80	1.33	4.48	1.32	cow_rm_7	0.0587
Neighbours are positive on the use of cattle manure	4.70	1.40	4.27	1.79	cow_rs_8	0.0269	5.32	1.12	5.22	1.08	cow_rm_8	0.4945
The positive effects of the use of cattle manure is emphasized by promotion/salesman	1.53	0.82	1.35	0.78	cow_rs_9	0.0827	2.88	1.68	2.47	1.61	cow_rm_9	0.0533

CONTROL FACTOR	CONTROL STRENGTH						CONTROL POWER					
	Positive intention (241)		Negative intention (81)		CODE	P-value	Positive intention (241)		Negative intention (81)		CODE	P-value
	mean	sd	mean	sd			mean	sd	mean	sd		
Transporting cattle manure is too difficult	5.96	1.12	6.43	0.81	cow_cs_1	0.0005	2.04	0.94	1.62	0.64	cow_cp_1	0.0002
Cattle manure is often not properly packed	5.88	1.21	6.33	1.01	cow_cs_2	0.0029	2.28	0.95	2.33	1.11	cow_cp_2	0.6882
I am unfamiliar with the use of cattle manure	4.41	1.93	4.81	1.80	cow_cs_3	0.1022	2.48	1.41	2.40	1.36	cow_cp_3	0.6467
Cattle manure is too expensive	3.82	1.74	4.20	1.83	cow_cs_4	0.0936	2.34	1.09	2.58	1.36	cow_cp_4	0.1087
I use my own chicken manure	1.28	0.59	1.27	0.82	cow_cs_5	0.9008	3.11	1.54	4.36	1.64	cow_cp_5	0.0000
The benefits of using cattle manure are not clear to me	3.50	1.78	4.44	1.84	cow_cs_6	0.0001	3.18	1.73	3.05	1.36	cow_cp_6	0.5298
Cattle manure is not available in my neighbourhood	3.83	1.98	4.21	2.19	cow_cs_7	0.1430	2.48	1.23	3.14	1.66	cow_cp_7	0.0002
Cattle manure is often too wet	5.86	1.15	6.25	0.94	cow_cs_8	0.0064	2.04	0.84	2.37	1.44	cow_cp_8	0.0118
The transport of cattle manure is too costly	5.90	1.22	6.47	0.79	cow_cs_9	0.0001	2.21	1.05	2.37	1.35	cow_cp_9	0.2636
Cattle manure is often too heavy	6.02	0.92	6.49	0.63	cow_cs_10	0.0000	2.39	1.05	2.69	1.35	cow_cp_10	0.0420
Handling and applying cattle manure is too difficult	5.72	1.27	6.37	0.87	cow_cs_11	0.0000	2.25	0.94	2.43	1.29	cow_cp_11	0.1706

Corresponding address for this report:
P.O. Box 16
6700 AA Wageningen
The Netherlands
T +31 (0)317 48 07 00
www.wur.eu/plant-research

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Corresponding address for this report:
P.O. Box 16
6700 AA Wageningen
The Netherlands
T +31 (0)317 48 07 00
www.wur.eu/plant-research

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