MISSION TO DEVELOP STRAW : A COMPUTOR BASED SOFTWARE PACKAGE (DST) FOR USE IN THAILAND, VIETNAM AND GUANGDONG PROVINCE, CHINA

CONSULTANTS REPORT

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Livestock Waste Management in East Asia Project
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SUMMARY

This report sets out the work carried out by consultants, Colin Burton (Cemagref, Groupement de Rennes)m Harald Menzi (Swiss Agricultural College), Peter Thorne (Stirling Thorne Associates) and to provide specific inputs to the project - *Livestock Waste Management in East Asia* - during their mission to S.E Asia in May 2009. The mission's principal objective was to consult national experts in each of the three participating countries (China, Thailand and Vietnam) on matters relating to the completion of the software package, STRAW. Previously known as MAUREEN, this software is a Decision Support Tool (DST) on manure management practices. This DST aims to assist local advisors in the specification of manure management systems (including treatment facilities, land spreading options or exporting manure products as appropriate) at future farms coming into the scheme. The broad principle is one of a balanced farm system in terms of avoiding nutrient excess by calculated application to local crops, export of surpluses as products or the destruction by treatment as possible. The production of biogas is included as a means to enable the above objective by enabling a reward for the implied investments. Other factors included in the decision making procedure include disease concerns and odour.

In each country, three principal meetings were held (i) a workshop to demonstrate the current version of the model and to gain feedback prior to finalising the package ; (ii) a session with data co-ordinator(s) to review the collection of specific data (both numerical and descriptive) ; (iii) a de-briefing session with the local PMO to inform about the state of activities and to enable a more general feedback. These meetings were supplemented with internal meetings during the mission.

Mostly favourable feedback was received from each team although the incomplete nature of the version of STRAW demonstrated limited a detailed analysis of the scope of the software. Dissemination of the model is expected in all countries but there were different expectations ranging from its application on specific farms on the one hand to its use as a general tool to help policy development on the other. Among the cautionary feedback were concerns over perceived problems in the ease of use and the relevance of the outputs to certain farming situations.

CONTENTS

1. INTRODUCTION - THE PURPOSE AND BASIS OF THE REPORT

1.1 Report context, structure and content

This report provides details of the work carried out by the consultants, C H Burton (CHB; Cemagref, Groupement de Rennes) H Menzi (HM; Swiss Agricultural College), and P Thorne (PT; Stirling Thorne Associates) during their mission to S.E. Asia from the 3 to 13 May 2009. This represented part of the set task to prepare a software programme known as DST (decision support tool) which will be a principal output of the parent project: known as *Livestock Waste Management in East Asia (LWMEA),* which formally started in August 2006 and will run for five years. This activity is part of component 4 of the LWMEA project which is implemented by the project RFO (Regional Facilitation Office) which is run by FAO in collaboration with the nation PMO's (project management offices) in the project countries Thailand, China (Guangdong Province) and Vietnam. Two other DST software packages will also be produced as tasks of this parent project : to distinguish the DST discussed here which relates to the management and treatment of livestock manures, this package is also known under the acronym now confirmed as STRAW (Support for the treatment and recycling of animal wastes) : it was previously known as MAUREEN.

The preparation of the STRAW DST is subject to a series of sub-contracts jointly describing an activity running from Dec 2007 to the expected conclusion in autumn 2009 with the launch of the software package produced. The requirements of this task were specified by previous preparation work carried out by C H Burton (2007) and H Menzi (2007) this work being based on two missions carried out in the study regions in 2007 (Burton and Menzi, 2007a and 2007b). A first mission was made under the current contract to present the outline software package in June 2008 (Burton et al, 2008).

A great deal of the work carried out during the current reported mission was based around a series of meetings with local experts. In consequence, for the most part, this report provides a series of minutes of these meetings making special note of factors shaping the STRAW DST. These are presented in chronological order grouped under the three countries involved in the project, Thailand, Vietnam and China (Guangdong province).

1.2 Mission objectives

The central objective of this second of two missions (under the current contract describing the task) was one of local feedback to the version of the draft software available at the time. The opportunity was also taken to finalise data to be used in the model data-file (a separate file for each country). "Data" in this sense implies both specific numerical values and a broader description of the farming systems common in each country or region.

Consultation was made via (a) workshops involving a selection of local agricultural experts invited by the PMO, (b) meetings with data co-ordinators (already contracted to the project) and (c) meetings with the local PMO's. In most cases, groups (a) and (c) comprised the same people and separate meetings were considered unnecessary.

In the case of data collection, the co-ordinators had been supplied in 2008 with extensive lists of requirements for specific information that describes the current farming systems, the related manure handling and implied costs. Complete data sets were generally received with respect to engineering data for China, Thailand and one each for the north and south of Vietnam. Data requested for agronomic calculations were incomplete for certain countries. Early in 2009, the coordinators were contacted with further requests for data especially missing or erroneous values. The process was complicated by the resignation of the coordinator for Thailand, the duties taken over by the PMO for that country. Thus, the opportunity was taken during this mission to review information amassed and also to clarify any misunderstandings. A final version of the data set is envisaged within 4 weeks of the mission completion.

A final mission is pencilled in for late autumn 2009 following the completion of the software package. This will effectively be the launch event and training for the software use: it will be followed by a brief report which will conclude the current project contract. A separate regional workshop is anticipated in early September. Although linked to the parent project and although a version of the STRAW software is expected to feature, this activity is not part of the current project. Participation of one or more of the authors of this report and mission will be subject to a separate contract.

1.3 DST Software application

The target audience for the DST under development has been the subject of much discussion especially during previous missions to the region in April 2007 incorporating related workshops. The outcome from these meetings was that the software should target especially ***those involved at the technical level including extension officers, local government, livestock advisors and academia***. One might expect its direct use by the largest farms but otherwise, ***it is not expected that the farmers themselves would use the package***. They would not be excluded but in the writing of the software, some technical awareness both of computing and manure management will be assumed. It was plain from the current mission that there remained some misunderstanding on the intended users of the STRAW software.

It is noted that the farmer may be involved in any use of the software concerning his farm both in supplying key data to the advisor/operator and in expressing his preferences in those parts of the programme providing choices. It is also noted that a minimal level of training will be necessary even for the target audience to ensure the best use of the software: the agreed approach (covered within the current project objectives) will be to “train trainers” during a launch mission set for late 2009 : some instructions will be documented.

To further ensure that the principal messages contained in the software package are disseminated to the farming community, a separate output from the project will be a series of 5 to 10 fact sheets (to be prepared in collaboration with the national PMO’s and local experts). These are not intended to replace the software package. Rather, the objective of such information sheets will be to make farmers aware of the options available to improve manure management on his farm. The sheets will thus in many

cases represent a first step in a review process of farm waste management. In all but the simplest cases, the completion of this process will be achieved by the subsequent application of the software package as described.

1.4 Itinerary of mission

The schedule of the mission is reproduced in Annexe 1. The mission visited Bangkok, Hanoi and Guangzhou and in that order. In each location there were three main elements: workshops with 4 to 6 local experts, a meeting with the appointed co-ordinator and (theoretically) a meeting with the PMO. This last element was intended to serve as a means of giving a formal de-briefing to ensure that all project partners were aware of the software development. In terms of time, 3-4 days (including travel) was allocated to each country enabling a full day for each workshop and each meeting with the data collection co-ordinators.

2. MEETINGS IN THAILAND

2.1 Preliminary preparation meeting

The software development group met soon after arrival to set out detail for the workshops for the mission. The broad plan was that following formalities, there would be a introduction to the model principles (CHB), followed by an overview of agronomic matters (HM), a resume of the treatment options (CHB) then a full demonstration of the model itself (PT). Following this, the participants would have time to use the model and to formulate their reactions and questions ahead of an open discussion session. This approach was used with minor modifications for the three workshops : the minutes of the discussion is reported here : the presented material is given in Annexe 2.

PT explained the current version of the STRAW model : this demonstrated the main working principles but it was clearly incomplete (some required input files still awaited) and it contained minor software bugs limiting its use. During the mission, software revisions were prepared each progressively moving towards a complete package but this will not be finalised until after the mission.

It was agreed that HM and CHB would prepare a written list of constructive comments and suggestions on the software during or soon after the mission.

2.2 Software development workshop - Thailand

Participants:

Mr. Arux Chaiyakul (DLD)
Mr. Nintaphant Kulpredarat, (DLD)
Dr Sommai Chatsangutrai, (DLD)
Mr. Adisorn Chanpraphalert, (DLD)
Dr. Noppadol Kongsricharoen (private biogas enterprise);
Dr. Wimarin (PCD),
Ms Sunee Tapinta (PCD);
Ms Nawarat Chalermpao (FAO),
Mr. Colin Burton,
Dr. Harald Menzi,
Dr. Peter Thorne

Dr Kongsricharoen left at lunchtime and the PCD representatives were only present for the afternoon session.

An introduction to the model and its objectives was given by CHB followed by treatment options and agronomic issues (HM). PT then presented the model itself and allowed some hands-on experience.

Feedback discussion

The aim of the discussion was to receive feedback from the participants on their first impressions of the model and suggestions about aspects that should be changed or

added. They should also evaluate if the level of detail of the input data and outputs is adequate and realistic for the intended user and if the tool corresponds to the needs of the project and the potential users. Most of the participants in Thailand appeared to pick up the use of the software rapidly; being able to establish new scenarios for themselves without further inputs from the three of us. This would suggest that, in terms of generally usability, we are on the right track.

Scenarios and general aspects

- "Quick scenario" is difficult to understand. A clearer definition and a better terminology will be chosen.
- There should be different standard scenarios for each country. Guidance has to be included to select the best one. A standard user will only have to enter crucial farm specific data like animal numbers and crop surface available for manure recycling, while all the rest is given in the default values of the standard scenario. An intermediate user can change individual values (e.g. feed composition). Advanced users might also generate their own default data sets, but this will be the exception.
- It might be interesting to make comparisons between different scenarios. This could either be as a direct comparison on the screen or on print-outs.
- There will be a final report that can be printed with a summary of the scenario, information for the user to implement the options chosen and instructions. This report will be assembled by the model from different components. The overall appearance is not yet finalised.
- The question was brought forward if there would be suggestions on the "best" of several possible options? There will only be a limited number of "decision points", where direct choice between different options is possible. Here warnings will be included for unrealistic options and guidance will be given about what aspects to consider when making the choice.
- Liquid manure is hardly used as fertilizer in Thailand at present. Land application does have different consequences. The model does not prescribe land application but it shows the environmental load when the manure it is not applied to land.

In response to reactions to the "Look and feel"

- There should be a save button. At present everything is automatically saved so that nothing gets lost.
- There should be a help button. This will be implemented.
- There should be a "back" button.
- Would it be possible for the user to select the colour of the graph? This would be possible.
- It would be better to have biogas as the first option rather than the alphabetical order.
- The pictures on the "Home" are not quite adequate for the project.
- The appearance of the top of the page (especially "Home") should be checked again.

In response to the request for feedback on User inputs (level of detail)

At the moment only the aeration module is fully implemented (with the exception of

the output reports) in the model. It serves as an example of the level of detail and the appearance of the treatment option. The following aspects were discussed:

- There is an opinion that the level of detail of the aeration input panel is insufficient.
- The crop area available for manure use should also be shown on the input page, even though it is a result. Thus it would give the user an impression of the area needed depending on the inputs.
- Key information about the treatment system should be given, but it should be simple and easy to understand.

Parameters to consider when evaluating the crop surface available for manure recycling

When evaluating the crop surface available for manure recycling, several aspects should be considered: Crop, season of nutrient requirement, distance, general accessibility with feasible equipment, what equipment can be used, accessibility during rainy season, surrounding area (settlement, rivers, protected area etc), what equipment can be used, certainty that the recipient will take the manure as expected. However, it would be too complex to quantitatively consider all theses aspects in the model. The following priorities were identified in the discussion:

- Specifying crop, season and distance are essential. The farmer is used to consider crop and distance but season is also important for the storage capacity.
- The surrounding area is also important, especially settlement and rivers, but it is hardly reasonable because we have no standard limits. The existing limits for “standard farms” are too strict.
- Crop, season and distance will be considered quantitatively in the calculated manure use plan. All other aspects will be mentioned in the detailed guidelines (to be prepared by HM).

2.3 Review of data collection - Thailand

CHB and (separately) HM met with Dr Sommai to discuss in detail all data collected over the previous year. The original data had been coordinated and submitted by Dr Thamarat of the AIT who subsequently resigned from the project late 2008. These duties were picked up by Dr Sommai on behalf of the DLD : consequently some important clarification was necessary to enable the completion of the task. The objective is to have all erroneous data corrected and the data file finalised by the end of May 2009. Concerning data on livestock production DLD will assemble its own values, irrespective of the data so far received during the AWI project, in discussions with Prof. Uthai Kantoo and from Dr. Thamarat. Concerning data on crop production, HM will supply the information received from Dr. Monkol during the AWI project for DLD to check with appropriate experts.

3. MEETINGS IN VIETNAM

3.1 Software development workshop - Vietnam

3.1.1 Introduction

Participants:

Ms Mai Huynh Thi (PMO)
Dr Bu Van Chinh (PMO)
Mr. Nguyen Vut Dinh (PMO – procurement)
Mr Nuguyen Si Ha (Translator)
Dr Phung Dinh Trung (Forestry expert)
Ding Ngoc Phuiong (Vietnamese Academy of Science and Technology)
Mr Nuguyen Huynh Thanh Danh (Kobelco Eco Solutions) – data collection – S Vietnam
Dr Huynh Thuy – data collection – S Vietnam
Dr Ngo Kim Chi – data collection – N Vietnam
Prof Pham Quang Ha (Vietnamese Academy of Agricultural Sciences)
Ms Nawarat Chalermpao (FAO),
Dr. Colin Burton,
Dr. Harald Menzi,
Dr. Peter Thorne

Ms Mai is the new project leader replacing Mr Duc. The software was presented to the PMO on the afternoon of the first day : the full workshop took place on the second day involving most of the participants listed above at some time or other.

Overview of software

STRAW is a system to assess manure streams from intensive livestock production with the aim of controlling negative impacts for the environment und supporting the user in choosing and implementing an optimal manure management strategy. The aim is also to use the livestock waste more efficiently by recycling it in crop production. The user can use the software to assess the current situation and the effect of interventions (e.g. various treatment options).

Introduction

STRAW is a standard software that can be run on any Windows computer. Its design is as user friendly as possible. The user starts on the “Home” page with various buttons to move to different parts of the program. A demonstration was run starting with a new scenario. The model is equipped with default data representing the standard conditions in every country to facilitate its running by different users. Every scenario starts with a livestock farm which has four possible basic waste streams (slurry, farmyard manure, solid dung, losses). Once the farm has been defined, some basic data must be entered (e.g. animal numbers). For each system appropriate treatment options can then be introduced. The model looks at N, P and K fluxes and also BOD and heavy metals (Cu, Zn).

At the moment the model is still an incomplete version of the software which showed

problems on some machines (e.g. we were able to identify and rectify problems experienced by some Windows Vista users). New versions will be circulated as the model advances. However, feedback from national experts is important at this stage.

Feedback discussion

The aim of the discussion was to receive feedback from the participants on their first impressions of the model and suggestions about aspects that should be changed or added and how the user friendliness could still be improved. They should also evaluate if the level of detail of the input data and outputs is adequate and realistic for the intended user and if the tool corresponds to the needs of the project and the potential users.

Scenarios and general aspects

- The beneficiary could not only be individual farmers but also cooperatives. In that case the scenario could be adapted to represent the average or different scenarios can be calculated for the individual farms.
- How can we print out input data and results? The final step of the calculation is the generation of different reports in PDF format that can be printed out according to the users requirements. The details still have to be worked out.
- What would be realistic options for the farmer, e.g. is the use of liquid manure for irrigation economically reasonable.
- The model depends on the objectives of the project. A model cannot be static. We have to follow different iterative steps. The first step would be a version to be checked by scientists. However the end-user will be a farmer.
- There are two main ecological (for surface waters) problems in Vietnam, P pollution and non point pollution for which livestock is the major source. Now the livestock sector shall be propagated which will lead to more waste. This waste must either be used as fertilizer or taken out of the system. We need a model to show how many animals are reasonable in a certain area. The Ministry of Agriculture must take a leading role.

“Look and feel”

- At the first view it looks nice. But we should think about the end user, which eventually should be the farm advisor. We have to be flexible for inputs. Important information should be shown, e.g. for which livestock category is as specific feed use.
- The user must have the possibility to change the data again and look at scenarios. The question of terminology is important, especially as the software will be translated to different languages.

User inputs (level of detail)

- If we ask too much, the user will not be able to provide it. If we ask too little, the results will not be reliable and representative. So we have to find the optimal level.
- Is it OK to give weight limits of pig categories?
- The amount of water used is very variable. A formula taking into account different input variables might be helpful.

Parameters to consider when evaluating the crop surface available for manure recycling

When evaluating the crop surface available for manure recycling, several aspects should be considered: Crop, season of nutrient requirement, distance, general accessibility with feasible equipment, what equipment can be used, accessibility during rainy season, surrounding area (settlement, rivers, protected area etc), what equipment can be used, certainty that the recipient will take the manure as expected. However, it would be too complex to quantitatively consider all theses aspects in the model. The workshop participants were therefore consulted what factors they judge essential to be considered quantitatively in the model. In the discussion on priority aspects the following points were mentioned, but opinions differed, which were the most important of these factors:

- Crop and season are very important.
- Accessibility, especially during the rainy season and slope can also be important factors.
- The agro-ecological zones might also be of importance.
- Pathogens might also be a problem.
- No organic fertilizer should be spread near rivers, especially during the rainy season.
- The surrounding area (settlement, protected area a like National Park) can also be an important limitation.

The following rather more general points were also discussed:

- 79 million tons of animal waste only supply 20-25% of fertilizer nutrient use.
- The main benefits of manure use are the saving of nutrients, the positive effect for the environment (less pollution).
- Manure (solid) is often an important income of livestock farms.
- When there is not enough local recycling capacity, manure has to be exported to other areas (e.g. for coffee or rubber). Solid manure is often transported across considerable distances.
- In different Provinces it is no longer allowed to transport fresh manure. This can be a serious problem especially for medium farms. This aspect will be covered in a special discussion.
- Liquid manure is a fast increasing problem because of the increasingly large farms and the increasing importance of liquid manure systems. Only very few farmers collect liquid manure. Its transport is also a problem.
- Apart from a manure composting standard from 1982 there is no legislation on composting and also no research centre. Once there will be such legislation it should be relatively easy to enforce it.
- In the past compost and manure were often used on cash crops and rice. Today mainly chemical fertilizer is used.
- Livestock production should be moved to areas with manure recycling potential (rural areas).
- Large farms tend to have biogas treatment today but there is often no local need for much of the biogas.

The issue of legal restrictions on manure transport was discussed separately with Dr. Chinh and Dr. Trung. According to the new Environmental Regulation of 2006

manure is a hazardous substance of category 2. However from the Regulation text of the meeting the implications of this were not obvious. Apparently the interpretation tends to differ between Provinces. A strict enforcement is for example practiced in Dong Nai Province, which has the highest livestock density country-wide. There transport is only allowed after a minimum of three months treatment. Dr. Chinh will try to collect more precise information and circulate it. Consequences for the project will then be exchanged electronically.

3.2 Review of data collection - Vietnam

On the final day, detailed discussions were held with the two teams of data-coordinators (Dr Thuy for the south and Dr Chi for the north). As for Thailand, each supplied data was discussed to ensure that there were no misunderstandings: erroneous and missing values to be supplied by the end of May to enable a complete and final data set for the model.

4. MEETINGS IN GUANGDONG PROVINCE, CHINA

4.1 Software development workshop - China

Participants:

Mr. Rao (PMO)
Ms Evonne Zheng (PMO) – administration
Ms Yolanda Huang (Translator)
Dr Ai (Institute of Soil and Fertilisers – Guangdong Academy of Agricultural Sciences)
Mr Yao Jianwu (as for Dr Ai)
Mrs Wang Ying (PMO) - procurement
Mrs. Nawarat Chalermpao (FAO),
Mr. Colin Burton,
Dr. Harald Menzi,
Dr. Peter Thorne

Mr Ou, the former project coordinator has since left the project his duties being covered by Mr Rao.

As for previous countries, the meeting commenced with a introduction to the model and the relating agronomic and treatment options (see Annexe 2). Before proceeding to the presentation of the model itself, Mr Rao gave a detailed and lengthy account of the application of technologies in the study area.

Review of project progress (Mr Rao)

The first stage of the project has been finished. In component 1 for demonstration farms 15 farms are involved, of which 7 have finished construction. The environmental monitoring has started for the first and second batch of farms and will soon start for the 3rd batch. However, resources will be limited for the 4th batch. Health monitoring is also in process. For policy research an institute in Beijing has been contracted. Research on additional topics is done be Dr Liao who has already submitted two reports. The project already has positive effects on the farms. Before the RCG meeting in September four pig farms will be visited to demonstrate this. Two research reports will also be presented at the RCG meeting.

Four different treatment strategies have been used. They all collect the manure in a collection tank and then have liquid/solid separation. The solid fraction is sold away fresh. The liquid fraction is brought to a biogas digester. The four systems then proceed as follows:

1. The biogas is used for grid electricity generation. The effluent is brought to a lagooning system where it will eventually achieve the national discharge standards and can thus be discharged. This model is suited only for larger farms (>35'000 pigs) with strong financial background. Such farms are ready today to invest into such a system as the see the financial benefits. They can generate electricity for 15-20 hours per day and for 24 hours during summer.

2. The electricity is used on the farm to prepare feed and for warming. The

effluent is first brought to an aeration pond and then to fish ponds.

3. As model 2, but the liquid effluent from the biogas fermenter is first brought to a storage pond and is then transported to crop farms for use as fertilizer. On the first farm practicing this system it is mainly potato. However, the use of liquid manure is seen especially promising on green vegetable, which are grown the whole year round.

4. As model 3, but surplus biogas is distributed to neighbouring households and schools with the aim to avoid the current practice to discharge excessive gas to the atmosphere. Two out of the 15 pilot farms have this comprehensive model.

The flow sheets presented in Chinese will be translated to English and circulated.

Current situation (Mr Rao)

No pig farm can meet the National Discharge Standards. Most farms discharge the manure directly. The Government cannot enforce the standards because this would mean closing down farms in a time when it is already difficult to meet the increasing demand for meat. The pragmatic approach of the Government therefore is to reduce pollution as far as possible. A reduction of 50-70% during the next five years is considered to be achievable and would certainly greatly reduce the pressure on the environment. However simple solutions are needed for this to convince as many farmers as possible. Encouraging examples of farmers that invested in new solutions were mentioned during the discussion. For example a farm that had serious problems because his wells were seriously polluted at first did not want to admit officials of DOA to the farm but later agreed to invest in a new system with 300.000 RMB Government support. Now the state of the wells has considerably improved.

General activities and aims of the Department of Agriculture (Mr Rao)

According to the experience made so far, Government intervention is necessary to put up recycling strategies for liquid manure. This intervention should include incentives and awareness raining activities to show the farmers the benefits of the new systems. One crucial question is, how much Government support is necessary for the investment. At present the critical limit for pig farms is around 50%. To demonstrate the model the Government has provided a first truck (3 m3 RMP 66.800), free of cost. For the next trucks the pig farmers will have to pay an increasing part of the investment (next 3 trucks 30%, later 50%). The truck is owned by a crop farmer having a contract with the Government. He has to carry running costs. Thus it is also guaranteed that crop farmers will not use excessive amounts of manure. A further important aspect is the transport distance because transport cost can become prohibitive at greater distances. It is also important to find crop farmers willing to take the liquid manure.

In principle it would be reasonable that larger pig farms process the solid manure on their farm to a marketable fertilizer. However, because of the humid conditions in Guangdong, they are very reluctant to do this, mainly because they would have to invest in manures stores. Their aim rather is to immediately sell the fresh manure and have no storage facilities of their own. So far, they have achieved this, except

during festivities, when they are therefore also ready to give away the manure free to prevent storage, problems with flies etc.

The Government has decided to install treatments systems on 2000-3000 farms during the next five years. After the discussion with the environmental protection department a meeting with more than 300 invited enterprises will be organized where STRAW might also be presented. The meeting is mainly targeted to the owners of the invited large pig enterprises.

The Government will support biogas reactors for small farms. It will contribute RMB 30.000 for reactors of 25 m3 and RMB 10.000 for additional 10 m3 up to a maximum of RMB 60.000.

Demonstration and discussion of the STRAW model (PT)

STRAW is a system to assess manure streams from intensive livestock production with the aim of controlling negative impacts for the environment und supporting the user in choosing and implementing an optimal manure management strategy. The aim is also to use the livestock waste more efficiently by recycling it in crop production. The user can use the software to assess the current situation and the effect of interventions (e.g. various treatment options). STRAW is a software package that can be run on any Windows computer. Its design is as user friendly as possible. The user starts on the “Home” page with various buttons to move to different parts of the program. A demonstration was run starting with a new scenario. The model is equipped with default data representing the standard conditions in every country to facilitate its running by different users. Every scenario starts with a livestock farm which has four possible basic waste streams (slurry, farmyard manure, solid dung, losses). Once the farm has been defined, some basic data must be entered (e.g. animal numbers). For each system appropriate treatment options can then be introduced. The model looks at N, P and K fluxes and also BOD and heavy metals (Cu, Zn).

At the moment the model is still incomplete and only available in English. New versions will be circulated as the model advances. However, feedback from national experts is important at this stage.

Discussion

Mr Rao acted as spokesman for the assembled team of local experts:

- The model is quite comfortable to use apart from the instability of the present version. When it is available in Chinese, it will be easy to use.
- This software is probably too advanced for our current situation but this might change in the future. The model can also be useful for research.
- Input data on livestock production will not be a problem. However, prices (e.g. for pigs or fertilizer) should be omitted as far as possible as they are very variable and uncertain.

Farmers will not use such a model. Pig farmers are just interested in a continuous stream of manure away from their farm and crop farmers know from experience how to use the manure. However, the model was always meant for the use by extension

services and officials as “decision support”.

The STRAW model could be used to develop standard systems for different farms sizes and structures, rather than for the assessment and design of specific individual farms, which would not be realistic.

Next steps

- A complete version of the model will be circulated as soon as possible.
- When the model is available in Chinese it will be given to some pilot farms to test and to their feedback in the workshop to be arranged by the PMO in Bolou County at the end of 2009.
- Some experts could also be invited to test the model and make suggestions for modifications.
- When the Chinese version of the model is available it should also be given to the Environmental Bureau.
- Mr Rao also mentioned the use of the model in support of up scaling their manure management systems in Guangdong province

Discussion of aspects to consider when assessing the manure recycling potential

When evaluating the crop surface available for manure recycling, several aspects should be considered: Crop, season of nutrient requirement, distance, general accessibility with feasible equipment, what equipment can be used, accessibility during rainy season, surrounding area (settlement, rivers, protected area etc), what equipment can be used, certainty that the recipient will take the manure as expected. However, it would be too complex to quantitatively consider all theses aspects in the model. The workshop participants were therefore consulted what factors they judge essential to be considered quantitatively in the model. In the rather general discussion of agronomic aspects the following points were discussed:

- Distance is an important cost factor for the transport of liquid manure.
- Pig farmers are not concerned about the manure use on the crop farms as long as they get rid of the manure. It is rather the role of the Government to consider the manure recycling capacity in an area.
- The crop farmers can be expected to use liquid manure according to crop requirements and to stop using chemical fertilizer on the crops fertilized with liquid manure. However, if the dose manure according to the N requirement, the might have a considerable oversupply of P and a strong accumulation of heavy metals. At present this is not seen as a priority problem because overuse of manure still produces much less pollution than discharge.
- Land can be used all year round in Guangdong. The season is therefore hardly a limiting factor for manure use.
- The amount of manure a farm can give away can vary considerably from day to day. This variability is often compensated by the use of manure in fish ponds.
- Livestock and crop farmers have long-term agreements on the use of manure.

4.2 Review of data collection - China

Prof Liao was unable to attend for the PMO and workshop combined session on day

1. Thus the session given over for data collection also served as an introduction of the STRAW model to Prof. Liao and subsequent discussion. Concerning data collection, the objectives and activities followed that for Thailand and Vietnam.

4.3 Concluding meeting (internal)

Actions agreed as follows :

- All outstanding technical data files must be supplied to PT by the **end of May** 2009.
- Output report format : HM to incorporate agronomic elements to the agreed draft (treatment already included) and circulate for comment by **end of May**.
- Data-files can be completed later (June/July) : PT to send out proforma's to CB and HM to enter final data set.
- Telephone meeting : dates proposed 16, 17 or 18 of June 2009. Check with PG before finalising date. Further meetings may be needed.
- All other input files not directly affecting programming (eg: text files, detail on advice to users, help files etc) to be submitted by **15 July 2009**.
- PT to complete full version of software **end-July**.
- Feedback from HM, CB and others on testing software by **end-August 2009**.
- Preparation of text file with all terms and files to be translated **end-August** : files sent to translator.
- Expected return of translation end September for inclusion in model.
- Preparation of final version of software in four languages **end-October**. (NB: some uncertainty whether the current contract requires the software in all four languages – English plus Chinese, Vietnamese and Thai : to check).
- Final mission (training of trainers) expected mid to late November. Some discussion on when to manufacture the CD's and thus effect the formal launch of the STRAW package. This could be done before the final mission thus enabling the distribution of the CD as a final action on the current project. However, this would preclude the inclusion of any final corrections to eliminate bugs subsequently found. The option of delaying the release of the CD by several weeks was thus put forward as an alternative strategy – to be discussed with P Gerber.
- Fact sheets : 5 to 10 specified to be ready to go out with the final software. HM to prepare a draft – double sided A4 – for discussion. This will be circulated by end-June.

5. CONCLUSIONS AND ACTIONS

General conclusions from the modelling development point of view (PT/HM)

1. The general approach and level of detail of the model is accepted by the partners in all 3 countries.
2. The general form of the model is seen as user friendly and adequate for the project needs. However, a broader check by various stakeholders will be necessary before the final release of the model (by possible circulation of complete draft after July – maybe with a questionnaire?)
3. The general approach is OK but the appearance of the model should still be simplified wherever possible.
4. It is crucial that the model can benefit end users from many backgrounds. However, a basic technical and IT knowledge of the user will be required to run the model. A direct use of the model by individual farmers without support from trained personnel was not anticipated in .
5. The general approach of the model is generally accepted in all partner countries. However, some minor adaptations in the presentation of required inputs and results will be necessary.

General conclusions from the agronomic point of view (HM)

6. Clear doubts still exist about the potential to use liquid manure on crops. However, the inevitability of such options is gaining increasing acceptance.
7. A wide range of aspects is relevant in the evaluation of the manure recycling potential of specific crop surfaces. However, it will not be possible to quantitatively consider all of them in the model. The crop (nutrient requirements), seasonal restrictions to manure use (e.g. rainy season) and the distance between livestock farm and manure application site (transport costs) will be the most essential elements.
8. The basic *default value information* is generally available in all partner countries. However, a detailed checking of the plausibility and congruency of different sources of information is still necessary.
9. The level of detail of reliable and accessible input data for livestock production will be best for pig production, followed by poultry production (especially laying hens and broilers). For cattle it will probably be necessary to base the calculations on average daily requirements per animal with taking into account the actual production efficiency level.
10. A differentiated assessment of the recycling potential of liquid and solid manure will be inevitable. The reliability of the assessment of the liquid manure stream will be limited at the beginning of the process, because experience of such practice is mostly lacking.
11. We recognize a clear increase in the awareness of project stakeholders for environmental impacts of livestock production. Such considerations might be perceived as inappropriate under the present economical conditions, but will certainly gain in importance in the near future.
12. The Chinese approach of shared costs of transport equipment for liquid manure (investment by livestock farmer and Government, running cost and ownership with crop farmers) merits close attention because it comprises various checks and balances.

General conclusions from the treatment system point of view (CHB)

13. There remain reservations amongst some local project partners with respect to using the STRAW model to specify and design treatment systems : this may indicate some difficulties in communication and understanding the proposed schemes but there is also evidence of reticence to commit to technology seen as expensive or inappropriate
14. The concept of “balanced agriculture” is not always appreciated or understood : consequently, the role of treatment outside profitable schemes may continue to meet resistance especially at the farm level. The challenge of communicating the idea of minimising nutrient surplus remains.
15. Of the treatment options, there is clear preference of schemes that generate a financial return meaning biogas, composting and (to a lesser extent) drying and sludge production. Complaints over odour and fears of disease from neighbours may yet be a pressure to introduce other more effective systems.
16. Design information on biogas systems will be welcome but it is noted that alone, biogas makes little difference to nutrient load and that the digestate must still be returned to the environment.
17. Unless there is electricity production, digestion is likely to produce too much biogas for local use leading to the risk of emissions of methane. Many existing biogas units are greatly undersized and very poor digestion can be expected : however, based on a minimum 20 days retention time, the implied digester volume from the model will seem too large based on local experience.
18. Composting and the related separation and settling schemes may yet be attractive if a market for the products can be found : such removal of organic material can greatly reduce the local nutrient load in terms of phosphorous.
19. Aeration remains the only *treatment* option to remove surplus nitrogen. Even with fish systems, its implied costs will greatly limit its use.
20. Lagooning may be the compromise technology if there is sufficient local land available. The implied treatment does not avoid the need for land application but it can greatly simplify the process.
21. Uptake of technology may yet be expected especially for larger commercial farms and groups of farms working together to organise a centralised facility. However, as in Europe, implementation of manure treatment strategies will generally imply an over cost to install and run which will not be freely accepted unless there is pressure on the farmers.

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Appendices

A1. Mission schedule
A2. PowerPoint presentation used in the workshops - introduction sequence - agronomic matters - treatment options