

**The potentials and constraints for crop-livestock interaction in Banteay Chhmar  
commune in the Banteay Meanchey province, Cambodia**



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## Table of contents

Table of contents.....	2
1. Acknowledgements.....	4
2. Abstract.....	5
3. Introduction to the study .....	6
These topics will be analyzed in the present report. ....	8
4. Methodology.....	8
4.1. Observations.....	8
4.2. Informal talks with key informants.....	8
4.3. Village Mappings.....	8
4.4. Questionnaire survey.....	9
4.5. Semi-structured interviews with key informants .....	10
4.6. Semi-structured interviews with farmers .....	11
4.7. Flow diagrams.....	11
4.8. Matrix Rankings.....	11
4.9. Seasonal calendars .....	12
4.10. Soil sampling.....	12
5. Results.....	13
5.1. General situation of livestock keeping and crop production.....	13
5.2. Livestock.....	13
5.2.1. Distribution of livestock.....	13
5.2.2. Purpose of livestock.....	15
5.2.3. Lack of Fodder .....	17
5.2.4. Lack of Water.....	18
5.2.5. Draft power .....	19
5.2.6. Manure .....	20
5.3. Animal Health .....	20
5.3.1. Diseases.....	20
5.3.2. Need for veterinaries.....	22
6. Links between livestock and crop production.....	23
7. Constraints and potentials of the crop-livestock interaction.....	26
7.1. Potentials of the crop-livestock interaction.....	26
7.1.1. Manure .....	26
7.1.2. Potential Investment.....	27
7.1.3. NGO .....	27
7.1.4. Diverse farm systems .....	27
7.1.5. Food Security .....	27
7.2. Constraints of the crop-livestock interaction .....	28
7.2.1. Increased cassava plantation .....	28
7.2.2. Diseases among cows.....	28
7.2.3. Lack of veterinary knowledge.....	28
7.2.4. Lack of water .....	29
7.2.5. Increasing debt .....	29
7.3. Application of fertilizer.....	30
8. Methodology reflections .....	33
9. Conclusion .....	34
10. Future aspects.....	35

11. References.....	37
12. Appendixes.....	38

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[M: Tarit                      C: Malene, Naja, Kerda]

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## **2. Abstract**

The present study was conducted in two villages Srash Chrey and Banteay Chhmar Tboung in Banteay Chhmar Commune, Cambodia. The aim of the study is to identify the potentials and constraints for crop-livestock interaction. In order to achieve answers on our objectives the various methods: questionnaire survey, semi-structured interview, soil sampling and PRA tools like village mapping, seasonal calendar, and matrix ranking were applied in the field.

On the basis of data obtained it is evident that disease of livestock and shortage of water are two major constraints for both livestock and crop production. This leads to a decrease in cattle keeping; a reduction in the amount of manure produced and therefore generates less output from the fields. As well the shortage of grazing land due to increased cassava cultivation is a big constraint for livestock keeping and may also continue as the amount of cassava cultivation is increasing.

One of the potentials of the crop-livestock interaction is that cow manure has a positive effect on soil fertility and is as well a cheap fertilizer. Moreover, diverse farm system where both livestock and crop production are adopted will lead to a greater interaction and make a more economic stabilization for the farmers, so if crisis occur, they are not too vulnerable. In addition, the Ecosorn/NGO workers are playing a useful role for the farmers through providing the opportunity to lend animals. The improvement of the veterinary sector should be ensured for keeping better health of animals.

### 3. Introduction to the study

[M: Kerda                      C: Naja, Malene, Tarit]

#### 3.1. Study site

The study site is in the commune Banteay Chhmar, situated 20 km east of the Thai border, in the northwestern Cambodian province, Banteay Meanchey. The province has an area of 6.679 km<sup>2</sup> and the total population is 586.571 out of which 28% and 72% of the population are living in urban and rural areas respectively. Banteay Meanchey is defined as one of the poorest provinces in Cambodia with 31-50 % of the provincial inhabitants living below the poverty line<sup>1</sup> (SCW 2006; [www.fao.org/nr/water/aquagstat/countries/cambodia/index.stm](http://www.fao.org/nr/water/aquagstat/countries/cambodia/index.stm) cited in “Introduction to field sites in Cambodia” provided script in class, 2009). In Banteay Meanchey two villages were chosen: Srash Chrey and Banteay Chhmar Tboung in order to know something about crop-livestock situation.

The climate in Cambodia is mostly governed by monsoons and has two distinct seasons: wet and dry season. The average annual rainfall in Banteay Meanchey ranges from 1000 to 1500 mm and is the province in Cambodia with the lowest annual rainfall. The annual average temperature in Banteay Meanchey is between 26.8 - 27.1°C (UN [http:// world weather.wmo.int/145/c00347.htm](http://world.weather.wmo.int/145/c00347.htm) cited in provided script in class 2009).

#### 3.2. Agriculture

Agriculture in Cambodia remains at a reasonably undeveloped state as farms are generally characterized by low input low output systems. Low input, the generally poor soil quality and the highly seasonal availability of water resources all contribute to comparatively low yields. The total population of Cambodia is 13.8 million out of which 9.6 million (69.3%) people are engaged in agriculture. The most important crop is rice, providing an estimated 70% of nutritional energy needs. Other important crops are cassava, water spinach, beans, cucumber, cabbage and banana trees. The soil of Banteay Chhmar is plinthite podzols - poor soil, therefore the soil has a low agricultural potential. Farmers of Banteay Chhmar are cultivating subsistence rain-fed rice, cassava and vegetables. Wet rice is grown once a year in the rainy season (FAO 2005; SCW 2006; UNDP 2004).

#### 3.3. Livestock

In the recent years there has been an increase in livestock. This is mainly due to improved crop production and an increase in the general welfare of farmers. The key livestock of Cambodia is cattle (cows and buffaloes), pigs and poultry (chickens and ducks). Cattle are the most expensive livestock to purchase and are often bought when family income permits it and is therefore a mean of investment and also used for

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<sup>1</sup> The poverty line is set for 1.036 Riel in rural areas (SCW 2006).

resource of manure. Pigs are often used as a family cash enterprise. Richer families can have their own sow used for breeding, and families thereafter sell the piglets or fatten them in order to get more money.

Poor farmers without a sow, buy the young piglets, fatten them and sell them at the market when they have grown big. Banteay Chhmar is among the communes in Cambodia with the highest number of families with cattle and pigs (between 750 and 1.500 families for both) (student research themes for ILUNRM 2009). About 90 - 95% of the households in rural areas keep chickens. Poultry is often recognized as one of the few livestock assets for poor households (FAO 2005). Most farmers own poultry. Chickens and eggs are important sources of protein in Cambodia and the chickens are therefore used as family consumption. When sold on the market, chickens give just a small income, but since they are often fed on broken rice and walk free, it is an easy source of income.

Some farmers have experienced a decrease in livestock. This is mainly due to diseases which is one of the biggest problems in the livestock sector (OIE 2004 as cited in FAO 2005).

The Government is investing in educating veterinarians but medicines are often still too expensive for farmers who cannot or will not pay medicine for their livestock (Ear 2005; FAO 2005).

### **3.4. Crop-livestock interactions**

In Cambodia the dominant mixed (crop-livestock) farming system is rice based. The land used for agriculture and grassland is closely connected with livestock production and management in relation to fodder supply and nutrient efficiency in the soil. Farmers provide fodder according to the feed habit of livestock and the rice fields are used for grassland after harvest. Crop-residues from the rice are used as fodder supply during the dry season. Although there is a growing tendency for farmers to apply inorganic fertilizers on the field, manure can be applied directly to the fields as organic fertilizers. To keep livestock also give better food security for families, if crop production are not so good in some years then they have opportunity to sell animals and thereby getting income to purchase food and to get a better crop production the following years (FAO 2005).

### **3.5. Objectives**

In relation to the study area and the situation identified here, the five main objectives are formulated as listed here.

The 5 main objectives are as following:

1. To categorize the different types of farms.
2. To identify the general potentials and constraints of livestock keeping.
3. To identify the links between crop and livestock production.

4. To identify the potentials of the links between crop and livestock.
5. To identify the constraints of the links between crop and livestock.

These topics will be analyzed in the present report.

## **4. Methodology**

[M: Malene, Tarit                      C: Naja, Kerda]

The used methods are to investigate situations seen from farmers in third world countries point of view and is as well chosen in order to gather the different disciplines within the group.

In order to reduce bias, triangulation will be used on different subjects so that crosschecking can be done.

### **4.1. Observations**

In order to reduce systematic bias from the data collected, observations have been done continuously from the time of arrival to the time of departure, so that collected data can be compared with observed situations.



### **4.2. Informal talks with key informants**

In order to find out which area we wanted to cover and get an overview of the villages in the area, we had informal talks with our local guide. During all of the field work knowledge and advices were gained through talks and walks with our local guide Mr. Sroun. In the end of the field work an informal talk with a teacher from the Royal University of Agriculture in Phnom Penh with background on animal nutrition, who gave information and overview of the livestock diseases in the area.

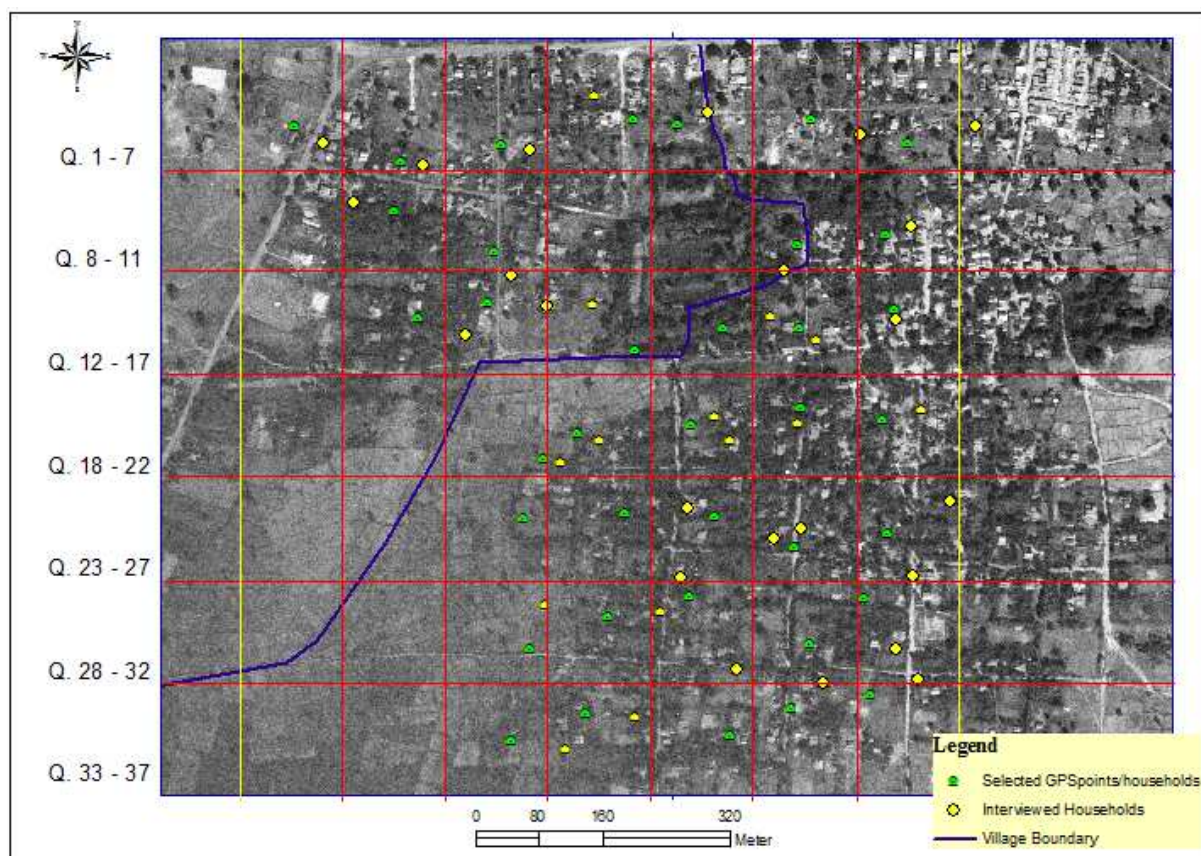
### **4.3. Village Mappings**

To get an overview of the two villages 5 – 10 farmers in the two villages were asked to do village mapping. These are used to have an overview of the resources within the village boundaries and to see whether the resources are related to the problems/potentials the villagers have (see appendix 10).



#### 4.4. Questionnaire survey

The target population for the questionnaire survey is 37 farmers living in the two villages - Banteay Chhmar Tboung and Srash Chrey. In order to do a random stratified sampling, we base the questionnaires at a spatial distribution. The stratified sampling provides us with a survey on farmers with livestock, with/without land and farmers from different social levels. The interviewed are both men and women and these are often attended by other family members, children and neighbors.



**Map 1: Random stratified sampling of 37 households based on a spatial distribution in two villages; Banteay Chhmar Tboung and Srash Chrey**

By conducting a grid-net upon an ortho-photo from 2003 that includes nearly the entire area of the two villages, we chose the 37 households to do questionnaire surveys. In each cell we pointed out on the map a household and wrote down the GPS-coordinates for these. When the GPS-point selected in arcGIS didn't turn out to actually be a location for a household in the field according to the GPS, we chose the house closest to the selected GPS-point. All the interviewed households are marked with a GPS-point as also shown at map 1. The two yellow gridlines are added to make extra cells, because not all cells within the red grid have houses. The numbers left of the cells are the numbers of the interviewed households.

After doing the interviews we made a village boundary to show where the two villages are divided. This is made from talks with our local guide and a bicycle ride along the village boundary line with a GPS to do the marks.

The information obtained from the questionnaire survey is used as general background information as well as some of the farmers also are used for semi-structured interviews (Appendix 8- tables and figures and appendix 5- questionnaire).

#### ***4.5. Semi-structured interviews with key informants***

In order to get more detailed data we did semi-structured interviews with key informants (see appendix 6 for interview guide line). The interviews are conducted according to a flexible guideline and questions are formulated based on the feedback from the interviewees (Mikkelsen; 2005). The first three interviews were held with village chiefs in Banteay Chhmar Tboung and Srash Chrey and the commune chief. These gave general introduction to the selected area.

Secondly, after basic knowledge about crop and livestock from questionnaire survey was obtained, we had interviews with two extension officers working for Ecosorn. The one had mostly knowledge about livestock and the other about agriculture. These interviews are used for general information on NGO supported projects and give aspects on the future potentials in the area. As last information in the field we interviewed a local veterinary in Banteay Chhmar Tboung. This was done in order to get a hold of the information about livestock diseases, as we conducted through all days in the field.



#### **4.6. Semi-structured interviews with farmers**

From the questionnaire survey 9 farmers were selected for semi-structured interviews (see interview guide line in appendix 7). The 9 farmers were selected based on divided groups according to the amount of livestock and land size. First the respondent was divided in to five groups as shown in Table 1.

**Table 1: Group division according to livestock**

Group	Description
1	>8 pigs and/or cows
2	3-7 pigs and/or cows
3	1-2 pigs/cows
4	Have only poultry
5	Have no livestock
Undefined	Households where we do not know the exact number of livestock

In order to choose the 9 farmers, 2 farmers from each group were chosen according to their size of land. The farmers having least and most land in each of the groups were chosen to be the respondent for the semi structured interviews. In case of situation where farmers have the same amount of land, they have been chosen according to the amount of livestock. Additionally two cattle farmers from another village were interviewed to conduct information about differences between villages and to interview farmers with a large amount of cattle. The purpose of the semi-structured interviews is to get in-depth information about the role of livestock. The interviewed farmers also did flow diagrams of his/hers particular production system to see the links between crop and livestock.

#### **4.7. Flow diagrams**

This tool was applied to identify the relationship/link between livestock and crop production including inside and outside farm activities. Together with the farmers from the semi-structured interviews a rough sketch of the flow of their production system was drawn (see appendix 12).

#### **4.8. Matrix Rankings**

In order to understand the constraints and potentials of livestock keeping and crop production two matrix ranking was made by two separate focus groups (Details are shown in appendix 3). The focus group was selected among farmers in each village by the village chiefs and included 6 – 8 farmers in each group.

#### **4.9. Seasonal calendars**

The two focus groups were also asked to do seasonal calendars. These are used to get an overview of the amount of work and the water resources in seasons (Appendix 3).

#### **4.10. Soil sampling**

In order to get information about the soil conditions with respect to use of manure and inorganic fertilizer in different fields, soil sampling was done. The hypothesis is that land in which manure is used are more fertile than land where inorganic fertilizer is used. To verify/falsify this hypothesis the main focus was drawn on the measurement of  $P^H$ , Potassium (k), Phosphorus (P), total Carbon (C) and Electrical Conductivity (EC).

Based on close distance of land from village and identification of fertilizer applied at the fields, four different fields of four different households were selected from the two villages for taking soil sample. The first field is rice field at 0.7 - 0.8 hectares where neither manure nor inorganic fertilizer was applied by the farmer but cows are grazing there during the dry season and water flow coming from adjacent forest area (the second field) in the rainy season. The second field is forest land which is connected with rice fields (the first field). The third (0.2 - 0.3 hectare) and fourth fields are rice fields where manure and inorganic fertilizer were applied respectively. For more about methods used for soil sampling see appendix 1.





## 5. Results

The data in this part is analyzed from observations, informal talks, questionnaires, semi-structured interviews with key informants and farmers, matrix rankings, seasonal calendars and village mappings.

### 5.1. General situation of livestock keeping and crop production

[M: Naja, Kerda C: Malene, Tarit]

The farmers of Banteay Chhmar Tboung and Srash Chrey are mainly occupied with crop production together with livestock keeping.

The general distribution of land is given in Figure 1. All households involved in the survey had residential land and 73 % and 43 % have rice field and cassava plantation respectively.

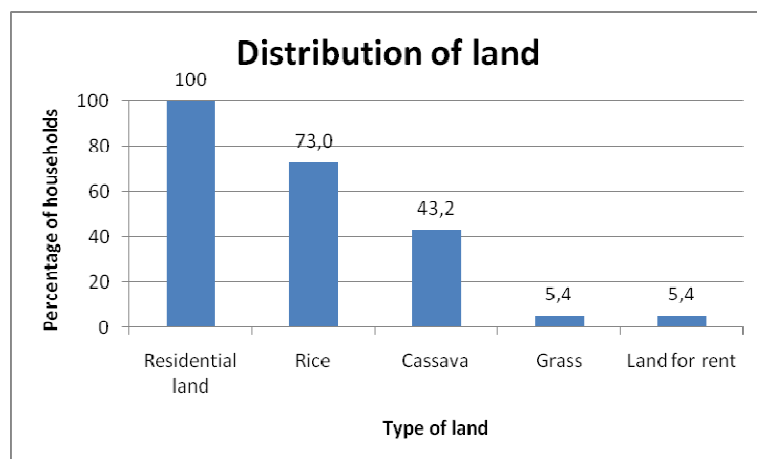
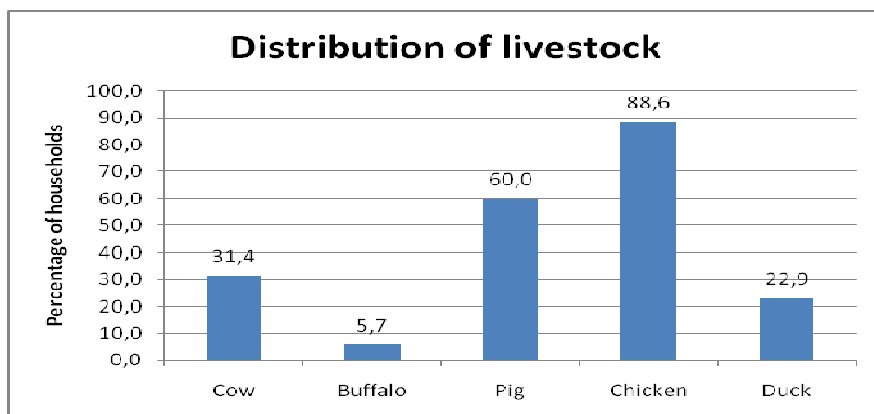


Figure 1: Distribution of land

### 5.2. Livestock

#### 5.2.1. Distribution of livestock

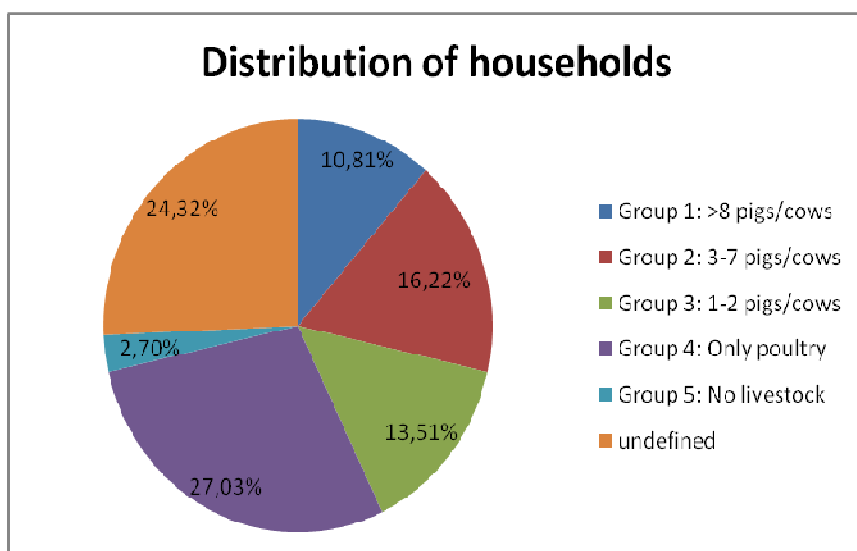
94.6 % of the farmers in our survey keep livestock. The distribution of the different animals is as shown in Figure 2. This tells us that poultry, especially chickens are the most common animal followed by pigs and then cattle. Chickens are thought as a livestock that is common for everyone to have, and most of the respondents in the survey that did not have chickens at the time of the survey, said that they actually used to keep chickens but they have all died recently.



**Figure 2: Distribution of livestock in Srash Chrey and Banteay Chhmar Tboung**

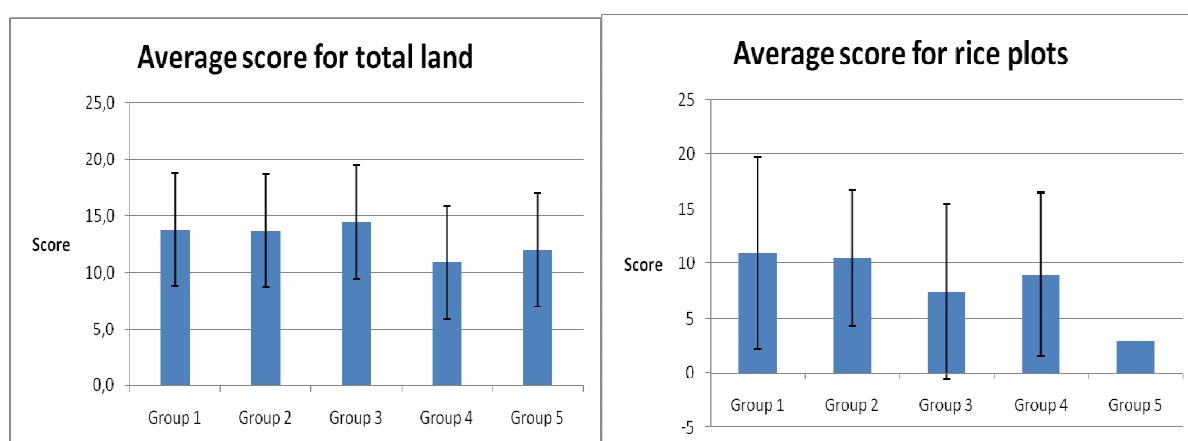


In Figure 3 the distribution of households according to the amount of livestock is shown (see part 4.6 for the division of groups). The biggest group is farmers having only poultry followed by group 2, 3 and then 1. The orange group with 24.32 % percent is when households have not answered how many of the different animals they have. For this reason we cannot classify this group.



**Figure 3: Distribution of household according to amount of livestock**

The distribution of land according to the groups is given in Figure 4. The total land score does not vary that much between the groups although there is a big variation within the groups (Appendix 9). However the size of rice fields is lower for group 5 than for the rest of the groups.



**Figure 4: Average scores for total land size and size of rice plots according to the 5 groups**

## 5.2.2. Purpose of livestock

The different animals have different purposes for the farmers and this purpose also differs according to how much livestock the farmers have as well as how their crop production is. How much time used for taking care of the animals differs from the different animals and on the size of the stock.

### 5.2.2.1 Poultry

Ducks are not really common in the two villages. The lack of water in the dry season and the fact that some households are situated far from the water sources is mentioned as a reason for not having many ducks or to have them at all. Ducks are raised in order to sell them on the market or to eat the eggs. Poultry is however very common. 88.6 % of the households with livestock keep chickens. There is not a big variation within how many chicken the farmers have according to group 1,3 and 4. The average amount of chickens is 6 for all three groups although it should be mentioned that when farmers are counting their chickens, they only count the full grown ones, therefore there could actually be some kind of variation here. For group 2 there are two farmers having more than 30 chickens making the average amount of chickens for group 2 to be 18. Chickens are used for consumption in the household but also to sell on the market. Chickens are walking around freely during the day and are kept at the household during night time. During the night time they are kept in a cage or underneath the house. Farmers having a lot of chickens are feeding them kitchen waste, rice or rice brans whereas farmers that do not have that many chickens are letting them eat whatever they can find during the daytime. Except for farmers having a lot of chickens, keeping chickens is not a big concern of the owner, the important part is to actually have just some. They do not generate a high income when selling but is still seen as a easy income they would not miss. This is also the reason for farmers who have lost all their chickens due to diseases, to buy some new ones.

#### **5.2.2.2. Pigs**

Except for one farmer who have 18 pigs, the amount of pigs varies from 1-6. This indicates that there can be different reasons for keeping pigs, but actually the purpose of raising pigs is some how the same for a farmer having only one pig and a farmer having 18. They are raised in order to generate an income if and when selling. Therefore the pigs are used as an investment or saving and is either sold when the family need money or in time of crisis. Having a wedding is also a reason for having less pigs, because pigs are also used for wedding gifts. Piglets are bought on the market or from neighbours and then fed until they are big enough to sell. Farmers having a lot of pigs and especially richer farmers, buy fodder from the market to feed the piglets and then feed the pigs porridge made from banana body and rice bran when the pig is getting older. Farmers that cannot afford to buy fodder, are feeding the piglets porridge as they would do with the big pigs. The actual nursing for pigs is not that time consuming, but the fact that pigs are used as a sort of saving or investment make people to ensure that the pigs are well fed. Pigs are normally kept in a cage or tied in a chain close to the house. After spending time in the villages and observing the different livestock, it seems reasonable to say that the pigs are the livestock that are living under the best conditions.

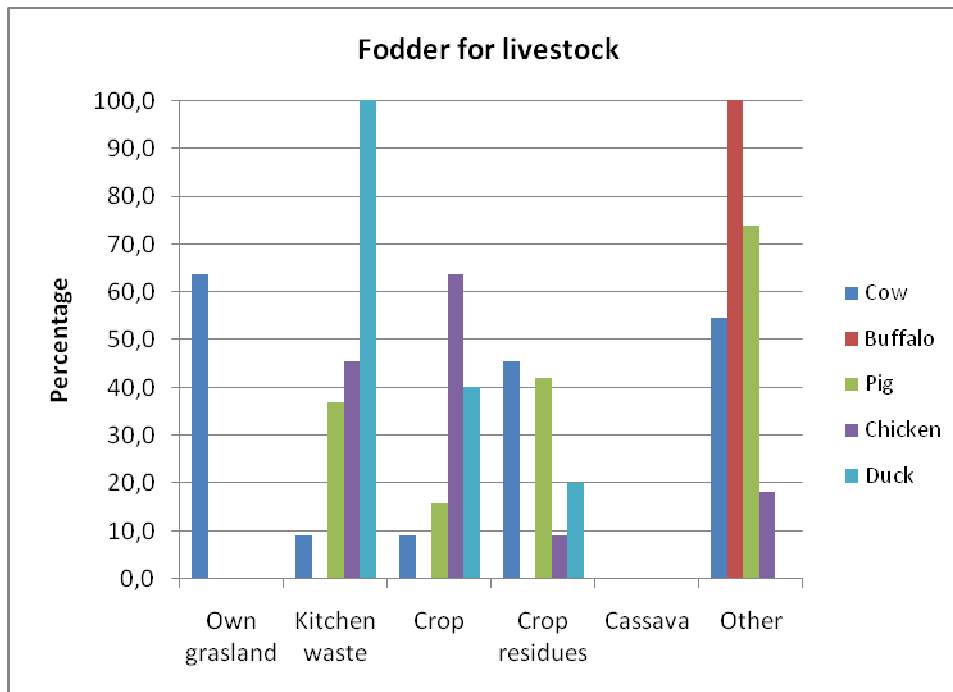
#### **5.2.2.3. Cattle**

The farmers (except the farmer with 18 pigs) in group 1 all have 10-13 cows. Otherwise the farmers having cows have 1-6 cows with the majority having only one. The purpose of having cows is very much similar to the purpose of having pigs. Cows are more expensive to buy than pigs and requires more time for taking care. On the positive side a cow can be sold for more money than a pig. This results in keeping cows is a very important mean of investment.

Cows are kept on grazing fields during the day and are tied and caged during the night. The transportation of the cows from the household to the grazing areas is time consuming. For some farmers the children or the men in the family have the responsibility for this task, and some farmers pay other people to take care of their cows. 12 % of the respondent kept their animals tied close to the household during the day. This was either because nobody in the family have time to take the cows somewhere else or because they do not have enough money to pay people to take care of their cows also to protect them from diseases. In the rainy season public grazing areas and forest land is used and during the dry season harvested rice fields is used for grazing. Rice straw and other crop residues is used as a supplement to the fodder for the cattle when grazing areas are not sufficient.



The different fodder sources for the livestock is given in Figure 5:



**Figure 5: Fodder used for the different livestock**

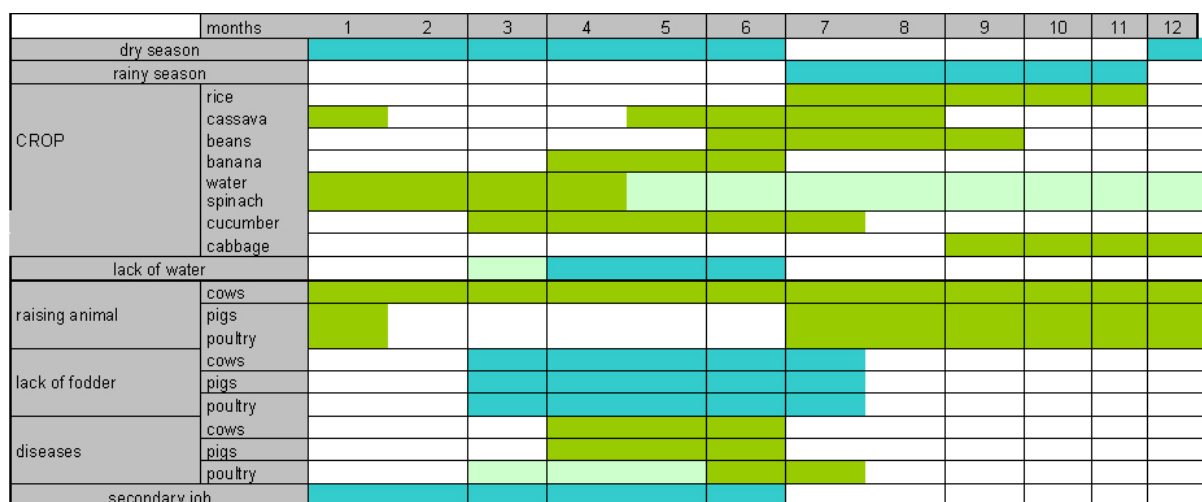
Besides showing the different fodder sources for the livestock, Figure 5 also tell us that farmers are not using cassava as fodder and that many of the farmers are using other sources as fodder. Some of the other sources is water spinach for the buffaloes and fodder bought on the market for pigs and cows.

### 5.2.3. Lack of Fodder

There are some problems related to providing fodder for the different livestock. Chickens and ducks are the only animals where none of the farmers have said that there is a fodder problem. However for the pigs and cows there are some problems. Rice straw is used as fodder for cattle and buffaloes in the dry season. In some years the season is too dry and then the yield is low. Farmers then do not have enough crops to feed the cattle and buffaloes. Rice bran is also used for pigs together with banana stems but not all households who have pigs have banana trees. Then they need alternative fodder sources for the pigs. It is possible to buy the fodder on the market but then they need money.

Figure 6 is picturing a seasonal calendar made by the villagers of Srash Chrey. The lack of fodder for pigs and cows are in this calendar closely linked together with the dry season. In the rainy season farmers cannot graze cattle on rice fields, because these are cultivated with rice. Some forest areas have been cut down in order to cultivate cassava and some forest areas are now classified as protected areas. This is the reason why

farmers also may have feeding problems during rainy seasons. Lack of grazing land is a limitation for cattle keeping.



**Figure 6: Seasonal calendar 1 (Srash Chrey, Cambodia, 09.03.2009)**

Crop production is affecting livestock in two different ways. A direct affect is crop and crop residues used as fodder, whereas some indirect uses are crops used in the kitchen and then kitchen waste are fed to the animals.

## 5.2.4. Lack of Water

Figure 6 also show that lack of water is a big constraint in livestock keeping and crop production. This is mainly of concern in the dry season. Households situated far away from water sources can have problems with lack of water. This can be dealt by transporting water to the households. When farmers do not own a handheld tractor they need to pay middle men for transportation of water. The seasonal calendar shows that some crops like cucumber and water spinach is cultivated in the dry season. In time of water shortage this has a serious effect on the yield from these plots. But lack of water is not only a problem in the dry season. Some years there is not even enough water in the rainy season resulting in lower yield.

People living close to ponds or moats around the temples do not have as many problems with water resources as the people living far away. Small lakes made of water from the rainy season are used for crop and livestock in the dry season, but is not suitable for human consumption. Small pumps can be used in order to get water for human consumption and these are situated around the village (Figure 7, see also appendix 10).

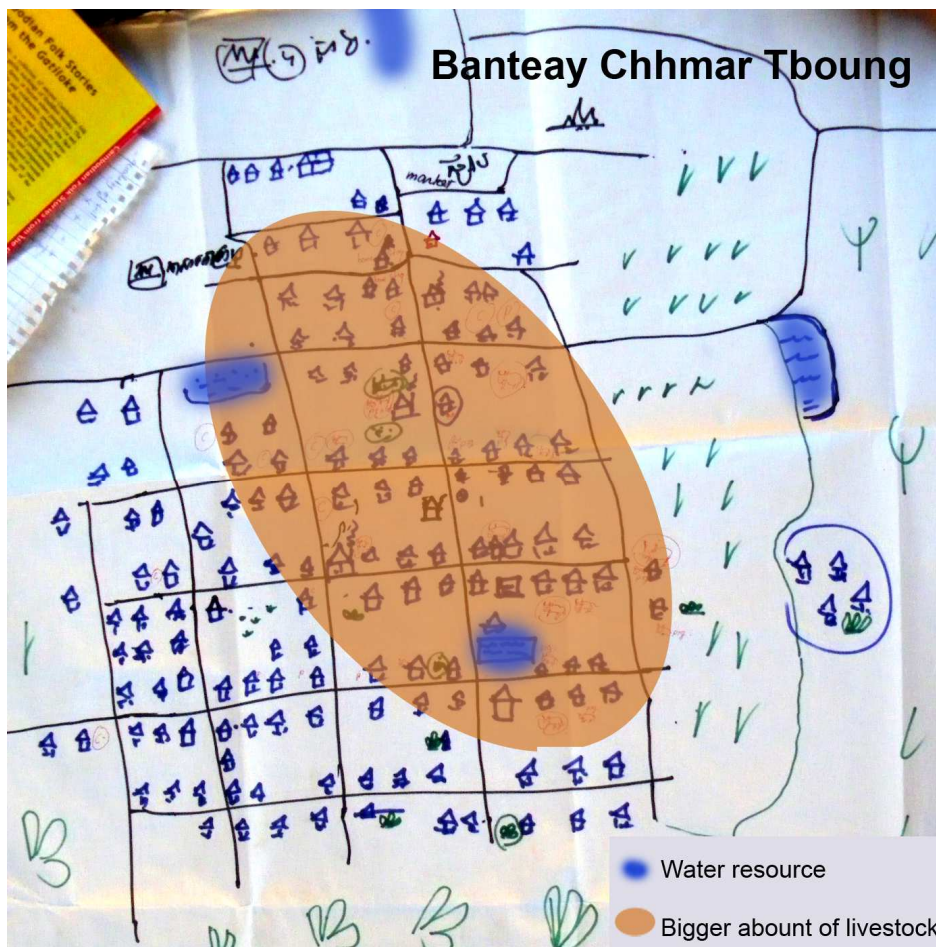


Figure 7: Village map with water resources marks made by farmers in Banteay Chhmar Tboung.

### 5.2.5. Draft power

The use of cattle as draft power for field operations is not a common sight anymore. Handtractors have taken the place of cattle and the result seems to be more satisfying for the farmers. A handtractor is expensive to purchase and the need for fixing when it brakes down, is the reason for a lot of farmers not to invest in their own handheld tractor. It can be easier and more cheap to rent a tractor from a neighbour. The handtractor is fast to operate on the field. Some farmers claim that it gives higher yield compared to using draft animals while some say that the output is the same. For plots situated far from the household time is an important positive change when shifting to tractor. It takes longer time for the cow to get to the field and the animals need rest and fodder during field preparation.



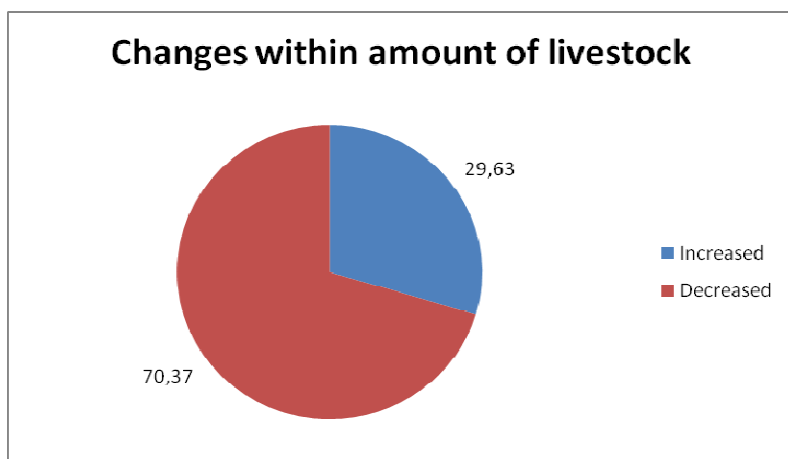
### 5.2.6. Manure

The use of manure on fields is especially for the ones who keep cattle. Farmers in group 1-3 are using the manure from cattle to put on their rice fields. Some farmers from group 4 and 5 who do not have any cows are actually buying manure from farmers with a lot of cattle. If farmers do not have enough manure, they supplement with inorganic fertilizers. Farmers having a lot of pigs are using their manure in their home garden, while many of the farmers only having one or two pigs do not use pig manure.

## 5.3. Animal Health

### 5.3.1. Diseases

One of the biggest constraints for livestock keeping is diseases. Lack of fodder and water, polluted environment and high temperatures are affecting the animal health. Feeding habits, such as lack of nutritional fodder make livestock sensitive for any kind of bacteria, viruses, parasites and other diseases. In the recent years 70.37 % of the farmers say that they have experienced a decrease in the amount of livestock (see Figure 8).



**Figure 8: Changes within amount of livestock**

This is mainly due to diseases among cattle. This means that farmers have lost their biggest manure source and therefore have to spend more money on inorganic fertilizers for the fields. Livestock numbers are still decreasing because village people are afraid to have new cattle because they do not know how to protect them against diseases, e.g. they do not separate the disease affected animals from healthy ones. Vaccines are still too expensive and veterinary help are not fast and good enough. Despite the expensive medicines 48 % of the farmers give their vaccinations to their livestock in order to protect them from diseases, whereas 28 % of the farmers heal their animals if they become sick.

According to the seasonal calendar 2 (Figure 9), which is showing some differences but still the same pattern as seasonal calendar 1 (Figure 6), diseases among livestock are most abundant in the end of the dry season and in the beginning of the rainy season. This is because of heat and big weather changes make animal intestines more sensitive towards diseases.

	months	1	2	3	4	5	6	7	8	9	10	11	12
dry season													
rainy season													
CROP	rice												
	cassava												
	beans												
	banana												
	water spinach												
lack of water													
raising animal	cows												
	pigs												
	poultry												
lack of fodder	cows												
	pigs												
	poultry												
diseases	cows												
	pigs												
	poultry												
secondary job													
access for vaccination													

**Figure 9: Seasonal calendar 2 (Banteay Chhmar Tboung, Cambodia, 09.03.2009)**

The most common known diseases among cattle in the area are Bluetongue, Parasites Fasilitator, Hemorrhagic Septicemia, Foot and mouth disease, lack of iodine, swollen stomachs and diarrhea (Appendix 2). Some of these diseases can be avoided if farmers have been giving vaccines. A problem is that many of the farmers have been expiring unknown diseases among their cattle and there was no chance to save the animals. This does not have a positive effect on the willingness of farmers to spend money on vaccines.

Concerning pigs the farmers do not face as many problems with diseases as cattle do. The most common disease among pigs is diarrhea, but in general farmers seem to have more faith in the vaccines used for pigs. There are a lot of problems with diseases for poultry in the dry season. Nearly all the farmers claim that many chickens die during the dry season.

### 5.3.2. Need for veterinaries

Table 2 shows the result of a ranking exercise made in Srash Chrey. The result from the problem ranking revealed that diseases among livestock were not the biggest problem. Lack of veterinaries scored 5 as being the biggest problem followed by diseases.

**Table 2: In this table total score number 5 shows the biggest problem and 0 the smallest.**

<b>Matrix ranking livestock</b>						
<b>Srash Chrey, Cambodia</b>						
<b>Problem</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
1 Diseases	0	1	1	1	5	1
2 Lack of fodder		0	3	4	5	2
3 Lack of water			0	3	5	3
4 Lack of labor				0	5	4
5 Lack of veterinary					0	5
6 Theft						0
<b>Total score</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>5</b>	<b>0</b>

The need for veterinary help is specially an issue for farmers with cattle. Cattle are the most expensive animal to buy and therefore diseases are a serious threat for farmers with cattle. Farmers are willing to pay for veterinary help as long as it ensures that the animals stay healthy. Pigs are also considered an important animal seen from an economic point of view and therefore farmers with pigs are also paying for vaccines and medicines. Farmers having only poultry usually do not spend money on medical treatments because diseases and death among chickens are considered as a natural and understandable way of the life cycle for chickens. Sometimes farmers use some medications to put in the drinking water for the chickens in order to cure them in time of disease.

#### Selection of animal medicines on the market.



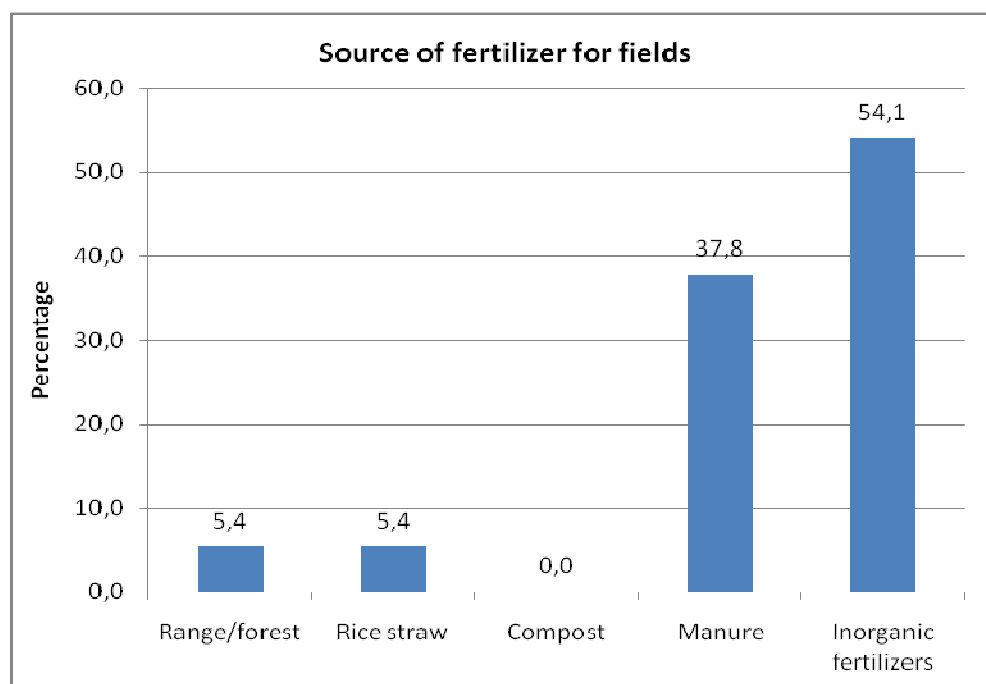


## 6. Links between livestock and crop production

[M: Tarit, Malene

C: Naja, Kerda]

There are different links between crop production and livestock. Some links are direct and are affecting each other directly whereas some are more indirect. According to the information from flow diagrams and semi-structured interviews, it is apparent that manure mostly from cows are used in the rice fields, manure from pigs and poultry are used either in own home garden or in neighbor home garden. Figure 10, also shows that 37.8% of the respondents are applying manure in the fields. The manure from cows and pigs is resulting in a higher yield from fields and home gardens.



**Figure 10: Source of fertilizer for fields**

Based on the information from questionnaire surveys, semi-structured interviews, flow diagrams, in connection with fodder, farmers are using crop residues, crop, kitchen waste and grassland as fodder source for cows, pigs, chickens and ducks. Specifically, rice straw and rice bran for all livestock, banana stem for pigs and rice grain for chickens and ducks are used as fodder. Furthermore, after the harvest a part of the crop residues tends to be freely accessible to all livestock and animals leave their dropping so all farmers receive some on their fields (Figure 11). In few cases, households without livestock but having rice fields leave the rice straws in the rice field. There they burn the rice straws and the ash will contribute to a better soil quality together with manure or inorganic fertilizer during the rainy season. This obtained output (high yield of rice) is used for investment of raising livestock providing themselves rice and rice bran as fodder.

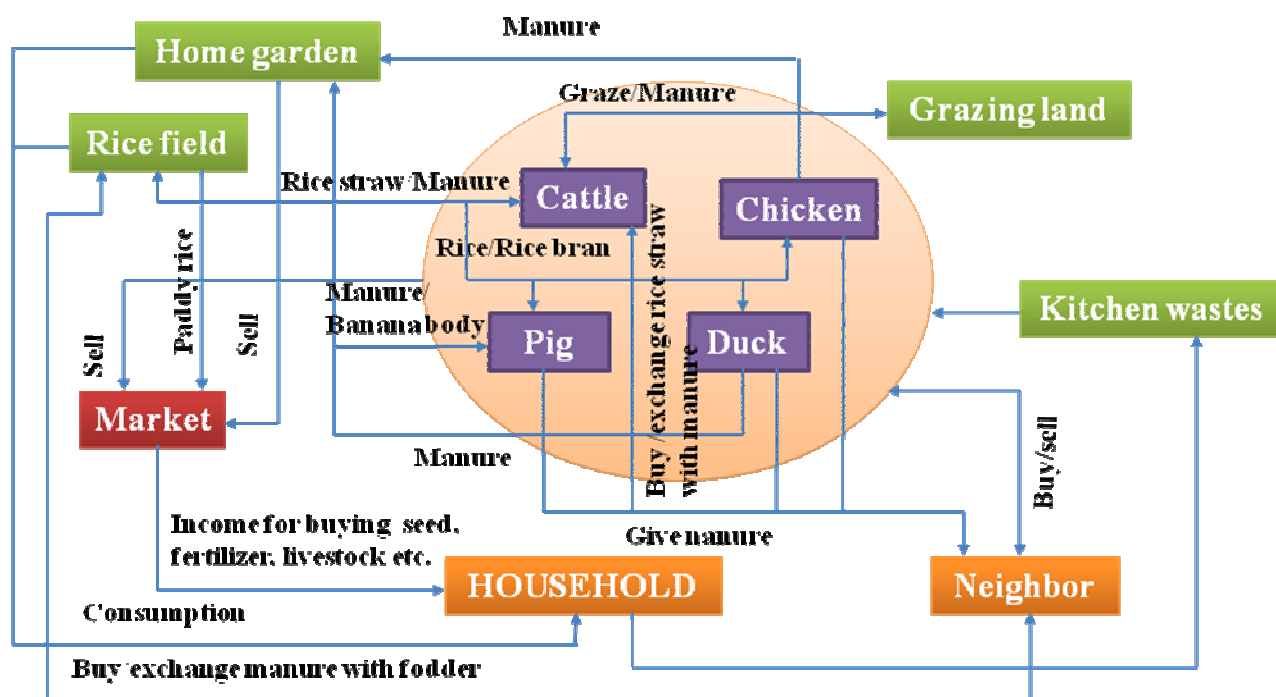
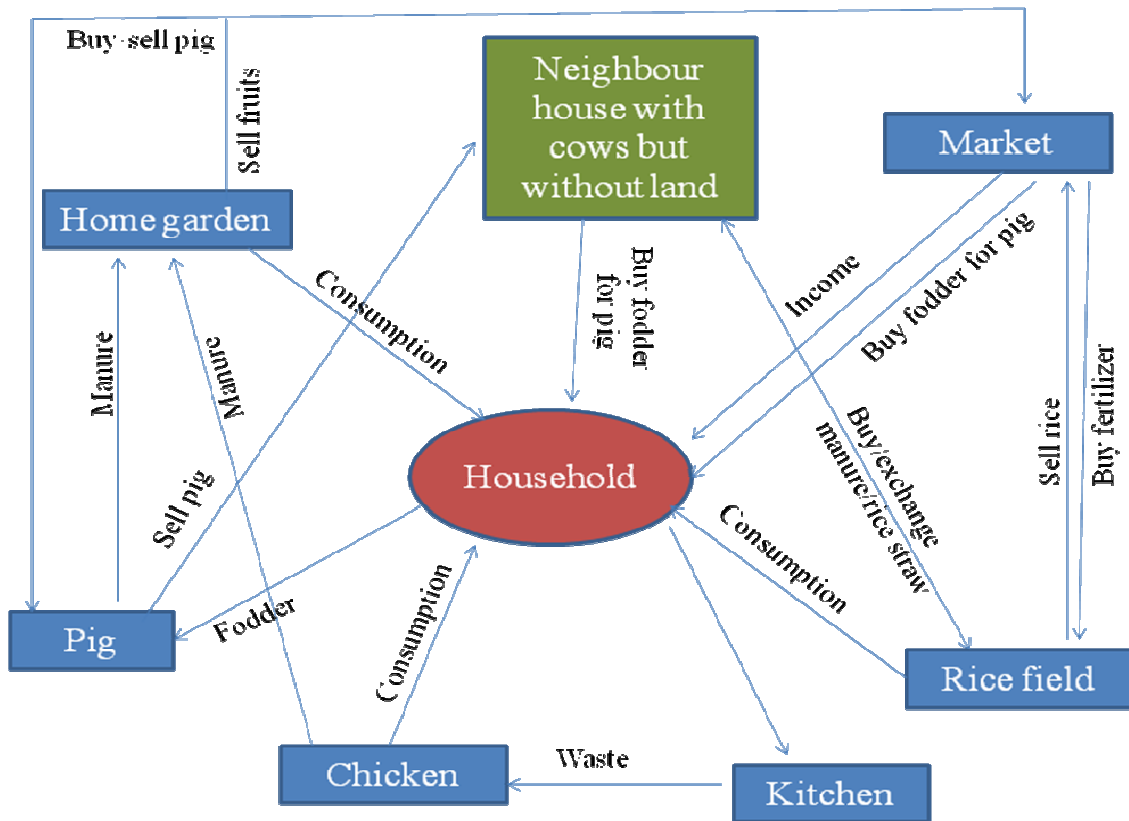


Figure 11: The general flow diagram of the link between livestock and crop production system.

The households without livestock (particularly cows) are getting or buying manure from neighbors to apply in the fields. Also, it was observed that the most households, who do not have cows, are buying inorganic fertilizer from the market but they are not using manure (Figure 12). Some farmers who have both rice fields and cows are also using both inorganic fertilizer and manure. In a few cases, the households with cows and pigs but no land, exchanges their manure with neighbors in order to get fodder from the household without cows but having rice field (Figure 12).





**Figure 12: The link between livestock and crop production system with respect to household having no cows but having rice field.**

The households without rice fields but having cows and pigs buy straw from neighbors for feeding the cows. Moreover, farmers without rice fields are buying fodder like rice bran from neighbors and from the market for pigs. Rice bran is the most common fodder for good growth of both pigs and cows. Sometimes, especially during the dry season cows grazing on neighbor or public grass land and cow dung are left in the fields and in rainy season these act as manure.

In most cases, kitchen waste is used as fodder for pigs, ducks and chickens (Figure 11 and Figure 12). The kitchen waste includes separated water from cooked rice and residues of fruits. The farmers also use water spinach from rice fields as a nutritive fodder for quick growth of pigs. It gives more manure if they feed nutritious fodder. In most cases, farmers are collecting banana stem for pig feed from their own home garden or the neighbor home garden where pig and chicken manure are used as fertilizer.

The return from sale of pigs, cows or manure to the neighbors or at the market is good income generation for buying good seed, fertilizer, labor and agricultural implements. On the other hand, sale of rice, fruits and crops from home garden gives opportunity to raise livestock (Figure 11).

## 7. Constraints and potentials of the crop-livestock interaction

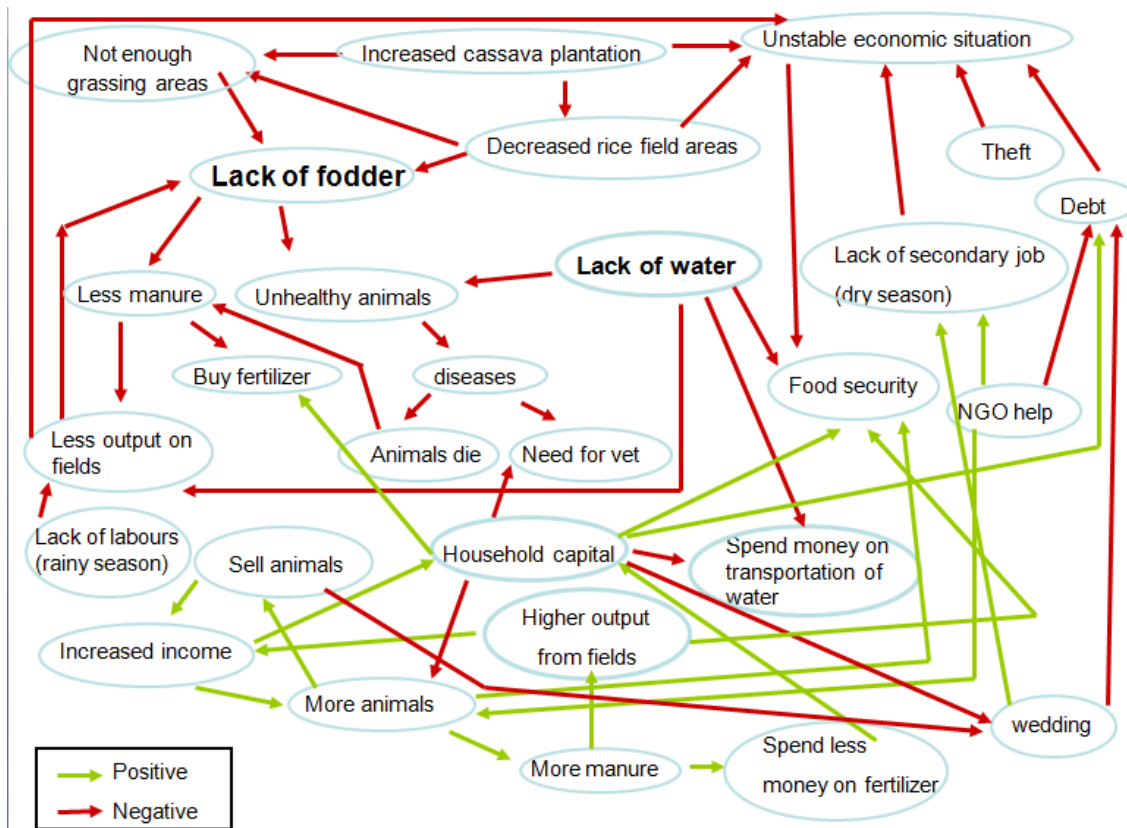


Figure 13 shows a cause-effect diagram picturing the interaction between livestock and crop. The green arrows are indicating what we find to be positive effects of the different situations whereas the red arrows are indicating the negative effects. Concerning manure focus is only at cattle, as cattle manure is the only organic fertilizer used on rice fields. The same is the case for the focus of the need of veterinaries in case of diseases – although this also includes pigs.

### 7.1.1. Manure

### 7.1.2. Potential Investment

The farmers invest in livestock in order to generate income when they later sell. A handful of the interviewed farmers say that they keep either cows or pigs as mean for selling, if the family has a wedding, unexpectedly need money for medicine or other things. As the situations in the text box, all show how big a potential keeping of livestock can be.

A female farmer from questionnaire no. 32 says that she uses chickens as saving account, and actually her living standards had now decreased as all poultry in the household died.

A man who was interviewed (14.3.2009) says, that the income he gets from selling cows is sufficient enough to send his children to school and let them have educations.



### 7.1.3. NGO

Being owner of a pig and/or cow can secure the household financially and be the beginning of a positive development within the households. However purchasing cows and pigs can be an expensive affair. A potential for making a positive development is the hope farmers get from a NGO working in the area. The NGO provides farmers with livestock from an animal bank, where farmers pay a certain amount back every month (More about this see part 10. Future aspects). In this way farmers are then becoming a more important part of the crop-livestock interaction and they are helped to increase the household's economic situation.

### 7.1.4. Diverse farm systems

Households having a diverse farm system including both livestock and crop production will lead to a greater interaction. If crisis occur e.g. rice harvest fail, then farmers can still rely on other parts of their farm systems such as selling some of their animals in order to buy rice on the market.

### 7.1.5. Food Security

Having as many links as possible in the crop-livestock interaction can have a positive effect on the food security of the household. Having both fields with crop production, home garden and livestock farmers are more susceptible to be self sufficient. When farmers have all these different sources of food they are more likely to have enough for own consumption. Moreover they are able to sell or trade some of their crop or livestock in order to buy other types of food and therefore become self reliant.

Another aspect of the increased food security is the stability of the household consumption. Having a diverse farm system gives a farmer more opportunities in time of crisis. The diverse farm system is also contributing

to a more food secure household by being able to provide adequate food in form of both different kinds of crops and different kinds of protein sources.



## **7.2. Constraints of the crop-livestock interaction**

### **7.2.1. Increased cassava plantation**

During the recent years there has been an increase in cassava cultivation. Some areas of forest land formerly used for grazing animals both in the dry and rainy season has been cut down in order to grow cassava. Some plots have as well changed from rice to cassava making them unsuitable for grazing in the dry season. The result of this is a decrease in grazing areas which makes it more difficult to provide fodder for the animals. This also leads to a lesser amount of crop residues used as fodder in the dry season.

Another negative impact from the increased cassava cultivation is the fact that cassava is not yet seen as a crop securing a stable income.

### **7.2.2. Diseases among cows**

Since late 2006 there has been a frequent outbreak of diseases among cows. This has led to farmers having lesser cattle and therefore having less manure to make their fields fertile. If there is not enough manure then farmers sometimes are forced to buy expensive inorganic fertilizers for their fields. Besides being expensive the result is a lesser output from the rice fields (see Table 3 – soil results).

Additional, diseases among livestock in general have a negative effect on the household security and can at the same time be a too big expenditure to prevent with buying of medicines. Therefore veterinary help and medicine are required to keep the animals healthy.

### **7.2.3. Lack of veterinary knowledge**

Referring to the need for veterinaries it is a constraint that the local veterinaries are not provided with enough updated knowledge within livestock diseases. This leads to an increase in diseases, which are difficult to cure. The available medicine is not helpful on new diseases and veterinaries do not know how to cure them.

Without new knowledge local veterinaries actually becomes as useless source, instead of the intended potential of actually having veterinaries.

#### **7.2.4. Lack of water**

During rainy season lack of water for the rice production will result in low yield. 29 % of the farmers actually say that they lack water for their rice fields (see appendix 8). This then gives a low output and the amount of crop residues used for fodder in the dry season.

Lack of water during the dry season affects the health of animals. Water sources used during the rainy season are dried out in the dry season and therefore cattle have to be taken to other water sources situated in more remote areas. The time it takes to walk the cattle to the remote water sources is time not spend on grazing. The households located far from water sources during dry season can be obligated to pay for transportation of water in order to have sufficient amount.

#### **7.2.5. Increasing debt**

The story from the textbox below tells us how big a constraint it can be to maintain the keeping of livestock and how much it actually affects the situation of the household, when getting into debt.

An interviewed farmer from questionnaire no. 33 purchase income from both farming, fishing and by selling labor (it gives about 1000 riel a day). He used to have 7 hectares farm land, but it had now turned into protected area so he is not allowed to grow crops there anymore. That was one of the reasons why he was chosen by the NGO to receive cow. Unfortunately the cow died last year because of diseases. He as well had 100 chickens but there was a disease among them, and now they also died. He can earn 100 bath by selling a dead cow in Thailand, but compared to 3000 bath for a live cow, he do not get any profit from a dead cow. He will ask neighbors for help when there are diseases, because his family do not have sufficient amount of money. His final solution is now to clear the forest (protected land area) as source of income, so he can pay back what he owns. But this is illegal work and sometimes the police come and want to arrest him. His solution for this is simple to pay the police money under the table, and it is still profitable for him and his family.

From a report made in the area, it is measured in percent how much debt families within the two studied villages have (See table below). As seen in the table the most people who get into debt are people from poorer households 70 % and 50 % respectively. As well it is noticeable that there is a great difference between the two villages. Even though the percentage of families in the poor group is higher in Banteay Chhmar Tboung, the amount of peoples who get into debt is the highest in Srash Chrey. The reason for this

can be many different aspects as we cannot see what the three strata groups are based at. The one thing that is certain by looking at the table is the fact, that the percentages of debt in the two villages are really high.

<b>Village - Srash Chrey</b>	<b>Rich</b>	<b>Medium</b>	<b>Poor</b>
<i>% of families</i>	7%	22%	71%
<i>Peoples get into debt</i>	0%	50%	70%

<b>Village - Banteay Chhmar Tboung</b>	<b>Rich</b>	<b>Medium</b>	<b>Poor</b>
<i>% of families</i>	8%	14%	78%
<i>Peoples get into debt</i>	0%	30%	50%

(See appendix 4)

### 7.3. Application of fertilizer

[M:Tarit C:Malene, Naja, Kerda]

In this part the effect of manure and inorganic fertilizer on soil quality is described.

Field type	Sample s	p <sup>H</sup>	K	P (µg/g)	C%	N%	C:N	EC( mS/cm)
Field -1 (using nothing) First block	A	7.96	450	6	0.59	0.05	12.88	0.108
	B	7.71	700		0.49	0.04	12.28	0.108
	Mean	7.84	575		0.54	0.04	12.58	0.108
Field- 1 (using nothing) Second block	A	7.38	700	15	0.55	0.04	14.66	0.036
	B	7.43	700		0.40	0.03	13.06	0.036
	Mean	7.41	700		0.48	0.03	13.86	0.036
Field -2 (Forest land)		6.87	700	3	0.86	0.07	12.41	0.072
Field- 3 (using manure)	A	7.19	450-750	5.5	0.33	0.03	11.89	0.036
	B	7.39	450-700		0.32	0.03	11.88	0.036
	Mean	7.29	450-700		0.33	0.03	11.89	0.036
Field -4 (using inorganic fertilizer)	A	6.59	700	4	0.39	0.03	11.85	0.072
	B	6.28	700		0.46	0.03	13.98	0.036
	Mean	6.44	700		0.43	0.03	12.91	0.054

Table 3: Results from soil testing - pH, potassium, phosphorous, carbon, nitrogen, carbon nitrogen ratio and electrical conductivity for four different lands.

Table 3 exhibits that all soils are close to neutral or slightly alkaline. The pH of field 1 and field 3 with manure applied is in high rating (7-8.5) which are indicating a decrease of availability of P and B. These pH values are indicating a deficiency of micronutrients Cu, Fe, Mn, Zn, while pH in the field 4 applied with inorganic fertilizer (6.44) is in medium rating (5.5 -7) and thereby the preferred range for most crops. For tropical crops like rice the optimum pH level is 5-6.5 (Landon 1991) which is similar with the findings of the field 4 applied with inorganic fertilizer. Plaster 2003 also mentioned the pH range 6-7 is a good average level for all nutrients and this is also the best pH range for most crops. This result is revealing that field 4 is more fertile than field 3 where manure is applied when considering pH-aspect.

The total C and N are quite low in all samples, which indicate sandy soils. However, the forest soil has a higher content of C (0.85%) and N (0.07%) compared to the rice field soils. Within the rice fields, the percentage of N is similar (0.03%) in both manure and inorganic fertilizer applied fields. Even the field where neither manure nor inorganic fertilizer is used shows comparatively better condition in N and C content with compared to that in field 3 applied with manure and field 4 applied with inorganic fertilizer although considering the C content the field 3 applied with manure contains less C than field 4 applied with inorganic fertilizer.

The C/N ratio is the measurement of rate of decomposition of organic matter and type (Washington State University 2008). The C/N ratio is found higher in inorganic fertilizer applied land than manure applied land indicating decomposition rate is low in inorganic fertilizer applied land with compared to manure applied land. The C/N ratio is highest (average 13.86) in second block of rice field -1 where neither inorganic fertilizer nor manure is applied; adjacent to forest land compared to other rice fields. The C/N ratio in the organic matter of cultivated surface commonly ranges from 8:1 to 15:1 (Brady and Weil 1999) whereas this soil type is sandy, less amount of organic matter content. In general, regarding C, N and C/N ratio there are no large differences between both the fields.

Regarding P, the ranges are low: <5, medium: 5-15 and high:>15 (Olsen and Dean 1965 as cited in Landon 1991) whereas the P content is lower in both forest land and field 4 but P content is found medium (5.5, 6, 15) in field 3 and both first and second block of field 1. This is the indication of a lack of P nutrient in field 4 compared to field 3 which is opposite to pH result.

Electrical conductivity (EC) values, in general, reveal that salinity is not a problem for all kind of land. Because the EC range 0-2, express salt free under which salinity effects are mostly negligible (FAO-Unesco

1973 as cited in Landon 1991). The more value of EC means the more salinity. Specifically, EC is higher in the field applied with inorganic fertilizer in comparison with the field applied with manure.

Regarding the analysis of Potassium (K), the findings shown in the table are too high for all fields which are unrealistic. This may be due to the improper method of working analysis.

In the light of above result it can be said that generally soil in fields 1, 3 and 4 was poor in macronutrients, micronutrients and organic matter content.

The conclusion of the soil testing is that there is no big difference on the soil quality whether manure or inorganic fertilizer is applied. Although no large difference was found field-3 where manure is used shows slightly better condition with respect to P, and C/N compared to field-4 where inorganic fertilizer is used. Soil pH in fields where manure is used is close to neutral. The fact that soil pH regulates microbial activity and decomposition of organic matter is higher at neutral level of pH (7.2) also indicates that manure is a better fertilizer. In our study it seemed that the application of manure was not sufficient enough. Field 1 where neither manure nor inorganic fertilizer is applied also shows better soil condition with regard to P, C and N content. The interesting thing is that second block of rice field 1 is close to forest land and cows are grazing there during dry season and they add dropping to the field. Also the water flow from forest tends to come to the field 1 adding some organic matter.



## 8. Methodology reflections

[M: Tarit, Malene, Naja, Kerda]

During our field study we noticed some positive and negative things from the methods applied in the study site.

A good idea after finishing every day work in the field would have been to meet together every evening to discuss and share the new knowledge we gained and made working strategies for the following day based on the shared new knowledge. We did it in some way, but concerning the e.g. the questionnaires, the reflections and thereby corrections could have been more. To have these group discussions during the evenings helped us to know what mistakes we have committed and making a plan for recovering these mistakes in next days. Also, regularly we contacted our teacher in order to get supervision.

From the onset of arrival at study site to the time of departure we observed the surrounding condition in the field which helps us to minimize bias of the result. Our local guide has given us a lot of information on the site and farmers present situation which helped us to get the overview of the area. His good connection and relation with farmers made our tasks easier with respect to soil sample collection and identifying farmers' field.

During GPS mapping we did not cover the entire villages in the grid for questionnaire survey so trends were not homogenous. Furthermore, some irrelevant and open questions with respect to the topic were put in the questionnaire that makes it long. And during conducting survey quite a few questions were not asked and some misunderstood between the person asking and the respondent, which have led to lack of expected answers.

Semi-structured interviews were based on 5 groups from the questionnaire survey. When we conducted questionnaires we did not ask any farmers whether it we could return for further information through a semi structured interview, as was the plan. Semi-structured interviews were more like a questionnaire and not an interview where the talk could move to other topics. Again, more questions have been put in the guideline.

A problem concerning the soil sampling was that some soil properties were measured in the field and this could also a possible source of error. This is mainly due to the simple laboratory facilities, as the soil samples were not even dried and mixed properly. Finally, some reflections were made about the group, counterpart and interpreter. It would be effective if more time would be spent with them to prepare activities and to make sure that we understand each other.

## 9. Conclusion

From the analysis and discussion we can conclude, that manure, as the main link between crop and livestock is good for the soil quality and is as well considerable cheaper than inorganic fertilizers. Manure is therefore really important to the crop-livestock interaction. It is because of the potentials of manure, that a diversified farm system also becomes a high potential. This is because the farmer having both crop and cattle can use the manure from his own cattle to apply at his fields and thereby get a better yield with the smallest possible spending. But even though the manure and keeping of cattle is a potential within the crop-livestock interaction, there are some constraints about the keeping of cattle, which we see now and which also may increase in the future.

The first big constraint is the diseases among both cattle and livestock in general. The fact that a lot of cattle die and that the local veterinaries does not have updated education and knowledge about new diseases make the keeping of cattle an insecure income source. The total amount of cattle has decreased during the last few years in the two villages and will continue, if no help is provided. The help that comes from the NGO – Ecosorn can make hopes for a brighter future in the area. The provision of lending animals gives the farmers opportunity to start raising livestock and more importantly gives hope for the local veterinaries to get the necessary training to help farmers cure the livestock diseases. This is of course as long as the cattle and livestock do not die before generating offspring and instead let the farmers get into debt.

Of course an obvious reason why the less cattle and thereby less manure is a constraint is the fact, that the farmers get less output from their field operations. Another big constraint is the increasing plantation of cassava. The cassava is not suitable for grassing and therefore the amount of places to grass for the cattle has decreased.

A constraint which is rather difficult to change is the lack of water. It is both a constraint for getting a high yield from crop production and as well a constraint, as the water need to be transported closer to the household and thereby become expenditure. The cattle needs to walk further to actually get water and then the cattle has less time for grassing and are exposed for more diseases while moving from one place to another.

In the future aspect Ecosorn or other NGO projects have an important part in maintaining a good and sustainable development within the keeping of livestock in the villages and around. A good place to start a positive development is to improve the role of veterinaries and their possibility to obtain new knowledge on the diseases for livestock.

## 10. Future aspects

[M: Malene                      C: Naja]

When we did the semi-structured interviews with the 11 farmers we asked about their point of view on how the future will look like. The answer to this has sometimes been difficult for the farmers to answer, as many farmers only work and think in the present time. But there is especially one noticeable issue that drops in mind - the fact that cassava plantation has increased and has taken some grassing areas, the villagers now claim, that they are in lack of grassing areas as fodder for their cattle. A lot of the interviewed farmers are afraid of the future situation, as they think this is an unfavorable condition for livestock keeping and that the spread of cassava will continue. In relation to this a great amount of the farmers say that they do not want to raise cattle as it can become a constraint to find fodder. On the opposite side a lot of the interviewed farmers think that the cassava will decrease because of lesser demand. This lower demand can in the future result in a renewed wish to raise cattle. This is to wish for the farmers, as having interaction between crop and livestock is best and improves the living standards of the farmers.

But as we have seen doing the constraints-part, it is as well a constraint to have an increased amount of cattle as the veterinaries are still not provided with the correct and updated knowledge on how to cure rather new diseases. The future of keeping livestock in the area doesn't look bright, unless if the improved knowledge about the animal diseases becomes improved.

The handheld tractor is as told earlier an increasing part of the farmers' uses on the fields. From the semi-structured interviews it is also discovered, that the ones who are not already owners of a handheld tractor, have the wish to invest in one in the near future. Of course the major reason for this is the time spend on labor, which the farmers can actually save.

When thinking about the overall future aspects, the concern is the increasing amount of cassava, unknown diseases and of handheld tractors, as we believe will lead to a continuing decrease of livestock keeping.

To prevent a negative development the villagers are helped by the Cambodian and European Union supported NGO organization – Ecosorn. The projects the organization cover are improvement, intensification, diversification and the increase of the livestock production.

As we have information from a project by Ecosorn that just started, an overview of how a project is planned will be shown here.



This project started late 2008 in three villages and is not yet carried through.

Economic and Social Relaunch of Northwest Provinces Project in Cambodia (ECOSORN Project) The main objective of the project is to contribute to poverty reduction through increased household income, particularly through increased agricultural sector productivity, and increased local community empowerment (<http://www.ecosorn.org/>).

The involved farmers get the possibility to participate in training on how to make compost. For the help to start raising livestock the farmers receive either a sow, calf or some poultry. The procedure starts by the Ecosorn workers choose a farmer from the village to be group leader of the helped receivers. The group leader is then responsible for dividing the animals amongst the farmers. The farmers who receive help from Ecosorn in the village are chosen by Ecosorn from following criteria:

Farmers which have  $\frac{1}{2}$  - 2 ha land, non smokers, no drinking and have the wish to raise animals. 12 farmers are selected (Interview Ecosorn - Agriculture)

The animals are provided as following:

Cattle: A 1  $\frac{1}{2}$  year old cow will be provided from Ecosorn and farmer A has it for two years. When the cow then calves, farmer A has to give away two calves for farmers B and C and the third calf, farmer A can keep himself.

Pigs: A 20 kg sow is given to farmer A. When the sow gives birth, farmer A gives away 3 piglets to farmer B and farmer A then keep whatever the numbers of piglets above 3 if any.

Poultry: 33 chickens and 16 ducks are provided to farmer A and he makes sure that these are divided fairly among the other receiving farmers.

Fish pond: The plan is also to help creating fish ponds and raising fish as an income. It is not yet started, but the plan is to give 4-7 fish in 1 m<sup>2</sup> (It all depends of the standard of the pond that is provided by Ecosorn).

(Interview: Ecosorn Agriculture)

Hopefully this project will have a positive effect on the future situation.

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## **12. Appendixes**

<b>Appendix 1</b>	<b>Soil samples</b>
<b>Appendix 2</b>	<b>Diseases for cattle</b>
<b>Appendix 3</b>	<b>PRA results</b>
<b>Appendix 4</b>	<b>Table taken from external report</b>
<b>Appendix 5</b>	<b>Questionnaires for farmers</b>
<b>Appendix 6</b>	<b>Guide line for semi structured interview with Key informants</b>
<b>Appendix 7</b>	<b>Guide line for semi structured interview with farmers</b>
<b>Appendix 8</b>	<b>General results from questionnaires</b>
<b>Appendix 9</b>	<b>Explanation for calculating scores in land size</b>
<b>Appendix 10</b>	<b>Village map made by group of farmers selected by village</b>
<b>Appendix 11</b>	<b>Data overview</b>
<b>Appendix 12</b>	<b>Example of flow diagram made by farmers</b>
<b>Appendix 13</b>	<b>Synopsis</b>

# Appendix 1

## Soil samples

### Potassium and phosphorus:

After collecting the soil samples they were dried and grinded to avoid greater than 2 mm stone. While being in the village potassium, phosphorus was measured. To measure potassium (K) 5 g of soil was extracted in 25 ml 0.5 M Ammonium Acetate ( $\text{CH}_3\text{COONH}_4$ ), the solution was shaken for 30 minutes and then filtered. Afterwards indicator paper was put in one test tube with 10 drops of reagent just in one second and then soaked into the extract for one minute and changed color of indicator was observed with reference to the given color.

For measuring phosphorus (P), 5g of soil was dissolved in 25ml 0.5 M Sodium Hydrogen Carbonate ( $\text{NaHCO}_3$ ) and shaken for 30 minutes. The samples were filtrated through filter paper, then acid and salt was added and we waited up to 7 minutes. Then the colors of the samples were estimated with reference to the colors given in the test-kit.

### Soil $\text{P}^{\text{H}}$ and Electrical conductivity:

To measure  $\text{P}^{\text{H}}$  and conductivity 5 g of soil was dissolved in 12.5 ml water and the solution was shaken for 30 minutes and the pH and conductivity was measured using a pH-meter and a conductivity test kit respectively in the laboratory.

### Total carbon:

Total carbon analysis involves conversion of all C forms to  $\text{CO}_2$  by dry and wet combustion and subsequent quantification of evolved  $\text{CO}_2$  by gravimetric, titrimetric or other techniques (Borggaard 2006). Soil samples were grinded using mortar and pestle and then put into machine.

## **Appendix 2**

### **Diseases for cattle**

#### **Bluetongue**

The bluetongue disease is a new disease in the area, as it was first time discovered in 2008. If the cow does not get veterinary help/injection in time the cow will die within few hours. Some of the major signs are fever, excessive salivation, swelling of the face and tongue and cyanosis of the tongue. Swelling of the lips and tongue gives the tongue its typical blue appearance, though this sign is confined to a minority of the cows. There is no efficient treatment. Prevention is effected via quarantine, inoculation with virus vaccine and control of the midge vector.

#### **Lack of iodine**

Lack of iodine is common for cattle. Neck edema does not let the cows to breathe and they choke very quickly (sometimes even in hours). They also attend running stomach. It is possible to vet with iodine and do it on the animal tongue and neck where it sucks fast, but in this case it needs to happen quickly before choking.

#### **Foot and mouth disease**

This disease is seen as when the cow has problems with the legs and difficulties of walking. The mouth gets infections and the tongue has spots. It either can eat. The disease is not the strongest of all, saying it's possible for the cow to survive. The farmers treat this disease in a traditional way.

#### **Hemorrhagic Septicemia**

The majority of cases in buffalo and cattle are acute or peracute with death occurring from 6 to 24 hours after first recognized signs. In a few outbreaks, the animal may survive as long as 72 hours. Dullness, reluctance to move, and elevated temperature are the first signs. Several of the sulfonamides and antibiotics such as penicillin and the tetracycline can be used successfully in the early stages. It is possible to give vaccination. The disease hits whenever there are changes in seasons and temperature. This is the disease many cows dies of. Especially the last 1-2 years it'll die within a few days.

#### **Parasites Fasilitor**

50- 60 % of the cows get this disease.

Fasiliasis – fasciola hepatica – common liver fluke, parasitic snails.

Fasiliasis – fasciola gigantica – parasite infects cattle and buffaloes and can also be seen regionally in goats, sheep and donkeys. The infection rates 80-100%.



## Appendix 3

### PRA results

13.03.2009 Cambodia

Seasonal calendar 1 - Pokea, Tarit and Kerda

Strash Chery

	months	1	2	3	4	5	6	7	8	9	10	11	12
dry season													
rainy season													
CROP	rice												
	cassava												
	beans												
	banana												
	water spinach												
lack of water													
raising animal	cows												
	pigs												
	poultry												
lack of fodder	cows												
	pigs												
	poultry												
Diseases	cows												
	pigs												
	poultry												
secondary job													
access for vaccination													

### Matrix ranking – livestock

Strash Chrey, Cambodia

Problems	1	2	3	4	5	6
1. disease	0	1	1	1	5	1
2. lack of fodder		0	3	4	5	2
3. lack of water			0	3	5	3
4. lack of labor				0	5	4
5. lack of veterinarian					0	5
6. theft						0
	4	1	3	2	5	

**Matrix ranking- crop  
Srash Chrey, Cambodia**

Problems	1	2	3	4	5	6
1. lack of money	0					
2.lack of water	2	0				
3. lack of fertilizer	1	2	0			
4. diseases	1	2	4	0		
5. insects	1	2	5	4	0	
6. lack of marketing	1	2	6	4	5	0
	4	5	0	3	2	1

**Table 4: Information on the participants Srash Chrey**

farmer	Animals	land (rice ha)	Occupation
1.Nap Nut	1 pig	2	Farmer
2. Tum Tylili	10 cows, 2chicken	3	Builder
3. Klip Veap	1 pig	3	Farmer
4. San Sōgm	9 cows, 1pig, 3 chicken	3	Farmer
5. Dod Njom	1 buffalo, 4 chicken, 3 piglets	2	Farmer
6. Kei Mal	5 buffalo, 2 chicken	1	Farmer
7. Sōön Sraab	20 ducks, 25 chicken	2	Farmer

**13.03.2009 Cambodia**

**Seasonal calendar 2 - Sroun, Naja and Malene**

**Banteay ChhmarTboung**

	Months	1	2	3	4	5	6	7	8	9	10	11	12
dry season													
rainy season													
CROP	rice												
	Cassava												
	Beans												
	Banana												
	water spinach												
	Cucumber												
	Cabbage												
lack of water													
raising animal	Cows												
	Pigs												
	Poultry												
lack of fodder	Cows												
	Pigs												
	Poultry												
Diseases	Cows												
	Pigs												
	Poultry												
secondary job													

**Matrix ranking- crop**  
**Srash Chrey, Cambodia**

**13.03.2009**

Problems	1	2	3	4	5	6	
1. lack of water	0	1	1	1	1	1	
2. insects		0	2	2	5	6	
3. lack of fertilizer			0	3	5	3	
4. technical knowledge				0	5	6	
5. draft power					0	5	
6. pesticides						0	
Total	5	2	2	0	4	2	

**Matrix ranking – crop**  
**Banteay Chhmar**

**Tboung, Cambodia**

**13.03.2009**

Problems	1	2	3	4	5	6	
1. disease	0	2	3				
2. lack of fodder		0	3				
3. lack of water			0				
				0			
					0		
						0	
total	0	1	2				

**Table 5: Information on the participants Banteay Chhmar Tboung**

sex (M/F)	Farmer	Animals	land (rice)	occupation
F	1. Tai Venn	cattle, pigs, chicken	1 rice field	farmer
F	2. Meun Hut	7 cows, 10 chicken, 2 pigs	yes	farmer & sell labor
F	3. Chey Ny	5 cows, 10 chicken	yes	farmer
M	4. M. Pen	4 cows, 5 chicken,	no	farmer
M	5. Kai Vannak	2 cows	no	farmer
F	6. Ok Phok	1 chicken	no	farmer
F	7. Mao Po Pha	None	no	farmer & sell labor

## Appendix 4

Table taken from external report

Villages	Families	Criteria	Rich	Medium	Poor
		% of families	8%	14%	78%
Banteay Chhmar Tboung	360	Rice field	10-12ha.	3-5ha.	0.5-2ha.
		Farm	2-3ha.	0.5-1ha	0.2-0.5ha
		Income source	Rice field, taxi-car, seller (market), Trader.	Rice field, cut firewood, charcoal, farm laborer and small grocery	Rice field, farm laborer, to work Thailand.
		Livestock			
		Cow	10-13	2-3	1-2
		Buffalo	5-7	3-5	0
		Pig	2-3	2-5	1-2
		Means of transportation	Car, Koyon, Motorcycle, Bicycle.	Koyon, motorcycle, bicycle and ox-cart	Bicycle, ox-cart
		Peoples get into debt	0%	30%	50%

Villages	Families	Criteria	Rich	Medium	Poor
		% of families	7%	22%	71%
Srash Chrey	162	Rice field	10-15ha.	3-5ha.	1-3ha.
		Farm	5-7ha.	0.5-1ha.	0.2-0.5ha.
		Income source	Rice field, grain mill, trader, truck and taxi-car.	Rice field, cut firewood, weaver, to work Thailand	Rice field, farm laborer, to work Thailand.
		Livestock			
		Cow	10-15	5-10	2-3
		Buffalo	0	0	0
		Pig	3-4	3-5	1-2
		Means of transportation			
		Peoples get into debt	Car, Koyon, Motorcycle, Bicycle.	Koyon, motorcycle, bicycle.	Bicycle
		Debt	0%	50%	70%

## Appendix 5

### Questionnaire for farmers

Interviewer: ..... Date: ...../...../.....2009  
 Village..... Commune: Banteay Chmar, District: Thmar Pouk, province: Banteay Meanchey  
 No. of questionnaire..... GPS-coordinates.....  
 Name of interviewee..... Sex: Male ☐ Female ☐

I. Family status:

1 The information of the members in the family

N°	Name	Sex (M/F)	Education/qualification	Occupation	Secondary job
1					
2					
3					
4					
5					
6					
7					
8					

2

Do you own land? Yes ☐ No ☐ Size? .....

Land	Size of land (ha)	When did you get it?
Residential land / Home garden (vegetables for own consumption)	<input type="checkbox"/> Less than 0.5 ha <input type="checkbox"/> 0.5-1 ha <input type="checkbox"/> 1,1-3 ha <input type="checkbox"/> More than 3 ha	
Field land (Rice)	<input type="checkbox"/> Less than 0.5 ha <input type="checkbox"/> 0.5-1 ha <input type="checkbox"/> 1,1 -3 ha <input type="checkbox"/> More than 3 ha	
Plantation land (cassava or other crops beside rice)	<input type="checkbox"/> Less than 0.5 ha <input type="checkbox"/> 0.5-1 ha <input type="checkbox"/> 1,1 -3 ha <input type="checkbox"/> More than 3 ha	
Grass land	<input type="checkbox"/> Less than 0.5 ha <input type="checkbox"/> 0.5-1 ha <input type="checkbox"/> 1,1 -3 ha <input type="checkbox"/> More than 3 ha	
To rent out	<input type="checkbox"/> Less than 0.5 ha <input type="checkbox"/> 0.5-1 ha <input type="checkbox"/> 1,1 -3 ha <input type="checkbox"/> More than 3 ha	

	More than 3 ha	
--	----------------	--

### 3 Which fertilizers do you use on your field?

Fertilizer	Sources	Cost	Other sources
Range/forest	<input type="checkbox"/> buy <input type="checkbox"/> Forest <input type="checkbox"/> Near by house	..... ..... .....	..... ..... .....
Rice straw	<input type="checkbox"/> buy <input type="checkbox"/> Own field <input type="checkbox"/> other	..... ..... .....	..... ..... .....
Compost	<input type="checkbox"/> buy <input type="checkbox"/> Own compost <input type="checkbox"/> Other	..... ..... .....	..... ..... .....
Manure	<input type="checkbox"/> Buy <input type="checkbox"/> Own animal <input type="checkbox"/> Other	..... ..... .....	..... ..... .....
Inorganic fertilizer	<input type="checkbox"/> Buy <input type="checkbox"/> Other	..... ..... .....	..... ..... .....
Other.....	<input type="checkbox"/> Buy <input type="checkbox"/> Natural <input type="checkbox"/> sources Near the house	..... ..... .....	..... ..... .....

### 4 Animal raising and management

a. Do you have livestock? ☐ Yes ☐ No

If yes:

Livestock	Number		Where do you keep the livestock	
Cow		<b>Family scale:</b>	Day:	Night:
		<input type="checkbox"/> draft animal <input type="checkbox"/> manure <input type="checkbox"/> daily food		
		<input type="checkbox"/> Other..... <input type="checkbox"/> <b>Commercial scale</b>		
Buffalo		<b>Family scale:</b>	Day:	Night:
		<input type="checkbox"/> draft animal <input type="checkbox"/> manure <input type="checkbox"/> daily food		
		<input type="checkbox"/> Other..... <input type="checkbox"/> <b>Commercial scale</b>		
Pig		<b>Family scale:</b>	Day:	Night:
		<input type="checkbox"/> manure <input type="checkbox"/> daily food		
		<input type="checkbox"/> Other..... <input type="checkbox"/> <b>Commercial scale</b>		
Chicken		<b>Family scale:</b>	Day:	Night:
		<input type="checkbox"/> manure <input type="checkbox"/> daily food		
		<input type="checkbox"/> Other..... <input type="checkbox"/> <b>Commercial scale</b>		

Duck	<b>Family scale:</b> <input type="checkbox"/> manure <input type="checkbox"/> daily food <input type="checkbox"/> Other..... <input type="checkbox"/> <b>Commercial scale</b>	Day:	Night:
Other	<b>Family scale:</b> <input type="checkbox"/> draft animal <input type="checkbox"/> manure <input type="checkbox"/> daily food <input type="checkbox"/> Other..... <input type="checkbox"/> <b>Commercial scale</b>	Day:	Night:

b. Has your amount of livestock increased or decreased after 2005?

☐ Increased

☐ Decreased

Why:

Why:

☐ Good conditions for expanding

☐ diseases

☐ Buy

☐ Theft

☐ Other.....

☐ Sell

☐ Lack of fodder

☐ Other.....

c. What are you feeding the livestock?

Livestock	Source
Cow	<input type="checkbox"/> own grassland <input type="checkbox"/> kitchen was <input type="checkbox"/> crop <input type="checkbox"/> crop residues <input type="checkbox"/> Cassava <input type="checkbox"/> other.....
Buffalo	<input type="checkbox"/> own grassland <input type="checkbox"/> kitchen was <input type="checkbox"/> crop <input type="checkbox"/> residues <input type="checkbox"/> Cassava <input type="checkbox"/> other.....
Pig	<input type="checkbox"/> own grassland <input type="checkbox"/> kitchen was <input type="checkbox"/> crop <input type="checkbox"/> crop residues <input type="checkbox"/> Cassava <input type="checkbox"/> other.....
Chicken	<input type="checkbox"/> own grassland <input type="checkbox"/> kitchen was <input type="checkbox"/> crop <input type="checkbox"/> crop residues <input type="checkbox"/> Cassava <input type="checkbox"/> other.....
Duck	<input type="checkbox"/> own grassland <input type="checkbox"/> kitchen was <input type="checkbox"/> crop <input type="checkbox"/> crop residues <input type="checkbox"/> Cassava <input type="checkbox"/> other.....
Other	<input type="checkbox"/> own grassland <input type="checkbox"/> kitchen was <input type="checkbox"/> crop <input type="checkbox"/> crop residues <input type="checkbox"/> Cassava <input type="checkbox"/> other.....

d. Do you have problems with feeding the livestock?

Livestock	Rainy Season	Dry Season
Cattle (cow, buffalo)	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes: ..... .....	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes:..... .....



Pigs	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes: ..... .....	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes:..... .....
Poultry (chicken, duck)	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes: ..... .....	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes:..... .....
Other	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes: ..... .....	<input type="checkbox"/> Yes <input type="checkbox"/> No If yes:..... .....

e. How do you manage your livestock?

Livestock	Manager	Duration		
Cow	<input type="checkbox"/> Father	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Mother	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Children	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
Buffalo	<input type="checkbox"/> Father	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Mother	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Children	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
Pig	<input type="checkbox"/> Father	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Mother	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Children	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
Chicken	<input type="checkbox"/> Father	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Mother	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Children	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
Duck	<input type="checkbox"/> Father	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Mother	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Children	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
Other	<input type="checkbox"/> Father	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Mother	<input type="checkbox"/> 1-3 hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour
	<input type="checkbox"/> Children	<input type="checkbox"/> 1-3 Hours	<input type="checkbox"/> 3.1-6 hours	<input type="checkbox"/> more than 6 hour

F.How do you manage the animal manure?

☐ Use it as Fertilizer   
 ☐ Sell it   
 ☐ Nothing   
 ☐ pther.....

III. Using Motorized Mechanization

- 1 Do you use motorized mechanization in your field operation? ☐Yes ☐No

How many.....

- 2 Why do you use motorized mechanization on your field operations?

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Easy to manage | <input type="checkbox"/> Less labor                  | <input type="checkbox"/> High price of animal; |
| <input type="checkbox"/> No animal      | <input type="checkbox"/> Expensive to keep livestock | <input type="checkbox"/> Higher yield          |
| <input type="checkbox"/> Other.....     | <input type="checkbox"/> Less time                   |  |

- 3 When did you start using motorized mechanization?

.....  
.....

- 4 Can you compare the yield between animal and motorized mechanization?

.....  
.....

#### IV. Crop management

1. When did you start to grow crop? .....
2. Did your change of crop production affect your livestock keeping? How?

.....  
.....

3. How do you use crop residues for?

- ☐Fodder ☐compost ☐sell it ☐ throw away ☐ other.....

4. Have you had problems with crop productivity?

- ☐Yes ☐No

5. If yes, which problems:

- |  |   |                                       |  |
|--|---|---------------------------------------|--|
| <input type="checkbox"/> Lack of labor | <input type="checkbox"/> lack of money      | <input type="checkbox"/> lack of time | <input type="checkbox"/> lack of water |
| <input type="checkbox"/> Poor soil     | <input type="checkbox"/> lack of fertilizer | <input type="checkbox"/> other.....   |  |
| <input type="checkbox"/>               | <input type="checkbox"/>                    |                                       |  |

6. Do you use pesticides on your fields?

- ☐Yes ☐No

#### V. Natural recourses

1. Do you have access to sufficient amount of water?

- ☐Yes ☐No

2. If yes, what is the purpose of the water:

☐ For the livestock      ☐ For crop production

3. If no, what is the purpose of the water:

☐ For the livestock      ☐ For crop production

## VI. Animal heal

1 What diseases are common in this area?

.....

2.what do you usually to deal with this crisis

a)Heal

b) sell

c)kill

d)have you got any prophylaxis

e)vaccination

f)no vaccination

g) others\_\_\_\_\_

3. when do they give vaccination ?

4.

Do you sometimes need veterinary help?

☐ Yes

☐ No

5. Do you have access for veterinary help?

☐ Yes

☐ No

6. If yes, what is the reason?

☐ Too expensive

☐

Don't have veterinary doctor in the area

☐ Other.....

## Appendix 6

### **Guide line for semi structured interview with key informant (Agricultural extension officer from ECOSORN with knowledge about livestock)**

#### *Presentation of yourself and the aim of the study*

- 1) Name, gender, age?
- 2) Working title/ position?
- 3) How long have you been living here?
- 4) Which animals are most common in Banteay Chhmar?
- 5) From where do people get their animals?
- 6) How are people managing their livestock? (Where and how)
- 7) Who is taking care/using the different livestock? (Gender, young/old)
- 8) How is the labor with cattle, pigs, poultry and ducks divided between women, men, and children?
- 9) How many hours of work per day are related to each kind of animal?
- 10) What is the reason for people having these animals?
- 11) What are they using the animals for?
- 12) Do the farmers sell/ buy fodder and manure at the market?
- 13) How many bags of fodder/manure can the farmer sell/buy?
- 14) How much does a bag of fodder/manure cost at the market?
- 15) Is there any positive things related to keeping livestock? (Cattle as a cheap method for draft and manure fertilizer, crop residue as fodder security in dry season)
- 16) Is there any negative things related to keeping livestock? (Diseases, access to fodder, theft, illegal trading)
- 17) What types of diseases are common and for which livestock? (swine fever common on pigs, Avian influenza – bird flu, Foot mouth disease – common on cattle, bluetongue, black leg, Newcastle – poultry disease, Lumpy skin disease? – maybe cattle and pigs, Pasteurellosis - cattle)
- 18) What is the solution to this problem?
- 19) Is there any lack of access to vaccines and drugs?
- 20) What is the solution to this problem?
- 21) If the farmers cannot afford the vaccines and drugs the animals need, what is the solution?
- 22) What is the alternative to keep livestock –if any?
- 23) What do you think will happen in the future with the livestock situation?

Are people going to have more/less livestock?

Is the distribution going to be different?

**Guide line for semi structured interview with key informant (Agricultural extension officer from ECOSORN with knowledge about crop production)**

*Presentation of yourself and the aim of the study*

- 1) Name, gender, age?
- 2) Working title/ position?
- 3) How long have you been living here?
- 4) How many households have their own land? What is the common amount?
- 5) What are they using their land for? (Crop, grazing, cassava plantation, vegetables, forest plantation, household, other)
- 6) How are people managing the field?
- 7) Are they using draft animals or mechanical machinery? (Chemical or natural fertilizer)
- 8) How is manure from each animal used? (fresh, dried, compost)
- 9) Do the farmers sell/ buy fodder and manure at the market?
- 10) How many bags of fodder/manure can the farmer sell/buy?
- 11) How much does a bag of fodder/manure cost at the market?
- 12) What is the alternative to land use –if any?
- 13) Have you noticed a change in the land use during the last years?
- 14) How is the soil quality at the different fields?
- 15) Are there any possibilities on changing the quality of the soils?
- 16) Why do you think that there has been a change/that things remain the same?
- 17) Do you think that there will be a change in the future?

Change in crop?

More cultivated land?

More mechanical equipment?

Change in fertilizer?

- 18) Identify and characterize monthly and seasonal agricultural activities carried out in the village in livestock crop production during a year.
- 19) Do you have any questions or comments?

*Thank you for your time and good bye*

## **Semi-structured interview with Village Chief**

### *Presentation of yourself and the aim of the study*

- 1) Name, gender, age?
- 2) Working title/ position?
- 3) How long have you been living here?
- 4) Which animals are most common in Banteay Chhmar?
- 5) Does anyone raise their own fish? And where?
- 6) If they raise their own fish, what do they then use it for?
- 7) From where do the farmers get the fodder for the fish?
- 8) From where do people get their animals?
- 9) How are people managing their livestock? (Where and how)
- 10) Who is taking care/using the different livestock? (Gender, age)
- 11) How is the labor with cattle, pigs, poultry and fish divided between women, men and children?
- 12) How many hours of work per day are related to each kind of animal?
- 13) What is the reason for people having these animals?
- 14) What are they using the animals for?
- 15) Do the farmers sell/ buy fodder and manure at the market?
- 16) How many bags of fodder/manure can the farmer sell/buy?
- 17) How much does a bag of fodder/manure cost at the market?
- 18) Is there any positive things related to keeping livestock? (Cattle as a cheap method for draft and manure fertilizer? crop residue as fodder security in dry season? other positive things?)
- 19) Is there any negative things related to keeping livestock? (Diseases, access to fodder, theft, illegal trading, animal instead of motorized mechanization)
- 20) What types of diseases are common and for which livestock? (swine fever common on pigs, Avian influenza – bird flu, Foot mouth disease – common on cattle, bluetongue, black leg, Newcastle – poultry disease, Lumpy skin disease? – maybe cattle and pigs, Pasteurellosis - cattle)
- 21) What is the solution to this problem?
- 22) Is there any lack of access to vaccines and drugs?
- 23) Where do you get the medicine from?
- 24) What is the solution to this problem?
- 25) What kind of medicines do you use? – traditional/chemical
- 26) If the farmers cannot afford the vaccines and drugs the animals need, what is then the solution?

- 27) What are the future solutions on these problems?
- 28) What are your thoughts on the future possibilities for keeping animals in this area?
- 29) Is there any alternative to keeping livestock?

### **Crop production**

- 30) How many households have their own land? What is the common amount?
- 31) What are they using their land for? (Crop, grazing, cassava plantation, vegetables, forest plantation, household, fishing, or other?)
- 32) How are people managing the field? (Crop production, grazing, cassava plantation, vegetables, forest plantation, household, fishing, or other?)
- 33) Are they using draft animals or mechanical machinery? Is there any constraints/possibilities related to this?
- 34) How is manure from each animal used? (fresh, dried, compost) (Fresh can be use for feeding fish, dry and composed are used in the field )
- 35) Are there any constraints on land use/ having crop production? (family crisis, people become richer, land crisis: land conflicts, soil infertility)
- 36) What is the alternative to land use –if any?
- 37) Have you noticed a change in the land use during the last years? – before and after 2005
- 38) Why do you think that there has been a change/that things remain the same?
- 39) Do you think that there will be a change in the future?
  - Change in crop?
  - More cultivated land?
  - More mechanical equipment?
  - Change in fertilizer?
- 40) Identify and characterize general monthly and seasonal agricultural activities carried out in the village in livestock crop production during a year.
- 41) Make a flow diagram on the different components in a production system (livestock, manure, kitchen waste, crop and water)
- 42) How do you think it's possible to improve the livelihood and what impact does different trends have? (Importance of population, resource, national/international, governance and technological trends?)
- 43) How do you think it's possible to improve the livelihood capitals?
- 44) Is there any constraints related to the distribution of crop production? - What about the future?
- 45) Do you have any questions or comments?

*Thank you for your time and good bye*

## **Appendix 7**

### **Semi structured interview with farmers**

#### **Group 1-3), the three groups with livestock**

- 1) Name, gender, age
- 2) How long time have you been living here?
- 3) How much livestock do you have?
- 4) From where do you get your animals?
- 5) How did you get the knowledge to raise your livestock?
- 6) What are you using the livestock for? (Why do you choose to sell some?)
- 7) How do you keep your livestock? (in more details: e.g. why are your chickens kept in at cage at night, why are the pig in a cage and do not walk around for free?)
- 8) How much and what kind of work is related to each of the animals per day? (i.e. taking care of them, giving them fodder and taking the cows to graze)
- 9) Do you sell/buy fodder and manure at the market? (How much per month and why?)
- 10) Which affect does the dry season and water shortage have for your family?
- 11) How much does a bag of fodder manure cost at the market?
- 12) Have you used more manure before, and if yes, what is the reason that you use less now?
- 13) How does manure change your crop yield?
- 14) Are there any constraints on providing fodder for your livestock?
- 15) Is there any positive things related to keeping livestock?
- 16) Is there any negative things related to keeping livestock (diseases, theft, access to fodder, low prices on market)
- 17) What types of diseases are common for which livestock?
- 18) What is the solution to this problem?
- 19) How do you manage livestock keeping after having diseases among your livestock?
- 20) How are you operating your land? ( i.e. do you do the job yourself, what kind of fertilizer are you using, draft animal/tractor.....on all the different lands!)
- 21) How much work do you use on land preparation?
- 22) How is manure from your animals used? (why choose chemical fertilizer or organic fertilizer, or how do you put the organic fertilizer on the field, why not using compost?)
- 23) Are you selling products from the fields? (within different kinds of crop)
- 24) Hove does the livestock keeping affect your financial situation?



- 25) Is there anything you would like to change/possible for you to change in your situation regarding livestock and land? (More machinery, cheaper fertilizer, more/less land, more/less livestock)
- 26) Do you think that your household will face any changes in the crop livestock situation in the future? (Positive/negative changes, more land, more livestock, changes in livestock or crop?)

### **Flow diagram**

Factors to be considered when doing the flow diagram:

Market, Kitchen, Mill, Neighbor

Crop: Rice, Cassava, Water Spinach, Bean, Banana, Watermelon, Grassland, Water resource

Livestock: Cow, Buffalo, Pig, Duck, Chicken

!: Women

+: men

For what purpose?

How?, what?

### **Group 4, only poultry**

- 1) Name, gender, age
- 2) How long time have you been living here?
- 3) How much land do you have (land size, entire, cultivated land)
- 4) What kind of crops do you cultivate on your land during the year?
- 5) Which crop gives more output/yield and income?
- 6) How much work do you use on land preparation?
- 7) Are you selling products from the fields? (within different kinds of crop)
- 8) How are you operating your land? ( i.e. do you do the job yourself, what kind of fertilizer are you using, draft animal/tractor.....on all the different lands!)
- 9) Do you face any problems with crop production? (manure, water, pests/insects, labor)
- 10) Which affect does the dry season and water shortage have for your family?
- 11) How many chickens and ducks do you have?
- 12) What are you using the poultry for? (Why do you choose to sell some)
- 13) How do you keep your livestock? (in more details: e.g. why are your chickens kept in at cage at night)
- 14) How much and what kind of work is related to keeping poultry per day? (i.e. taking care of them, giving them fodder?)
- 15) Are there any constraints on providing fodder for your poultry?
- 16) Do you feel any negative effects of having only poultry?
- 17) Do you feel any positive effects of having only poultry?
- 18) Did you use to have more livestock before? (What is the reason for you only to have poultry now?)

- a. If yes: is there a difference in yield now, compared to when you had other livestock?
  - b. If no: what is the reason for you only to have had poultry?
- 19) Have you used more manure before, and if yes, what is the reason that you use less now?
- 20) How does manure change your crop yield?
- 27) Is there any positive things related to keeping livestock?
- 28) Is there any negative things related to keeping livestock (diseases, theft, access to fodder, low prices on market)
- 29) Do you face any diseases of your poultry during the year?
- 30) What is the solution to this problem?
- 21) Is there anything you would like to change/possible for you to change in your situation regarding land? (More machinery, cheaper fertilizer, more/less land, more livestock)
- 22) Do you think that your household will face any changes in the crop-livestock situation in the future? (Positive/negative changes, more land, more livestock, changes in livestock or crop?)

### **Flow diagram**

Factors to be considered when doing the flow diagram:

Market, Kitchen, Mill, Neighbor

Crop: Rice, Cassava, Water Spinach, Bean, Banana, Watermelon, Grassland, Water resource

Livestock: Cow, Buffalo, Pig, Duck, Chicken

!: Women

+: men

For what purpose?

How?, what?

Flow diagram of the production system

### **Group 5, No livestock**

- 1) Name, gender, age
- 2) How long time have you been living here?
- 3) How much land do you have (land size, entire, cultivated land)
- 4) What kind of crops do you cultivate on your land during the year?
- 5) Which crop gives more output/yield and income?
- 6) How much work do you use on land preparation?
- 7) Are you selling products from the fields? (within different kinds of crop)
- 8) How are you operating your land? ( i.e. do you do the job yourself, what kind of fertilizer are you using, draft animal/tractor.....on all the different lands!)
- 9) Do you face any problems with crop production? (manure, water, pests/insects, labor)
- 10) Which affect does the dry season and water shortage have for your family?

- 11) Did you have any livestock before? (What is the reason for you not to have any livestock now?)
- If yes: is there a difference in yield now, compared to when you had livestock?
  - If no: why do you think you have never had any livestock?
- 12) Do you feel any negative effect of not having any livestock? (also in the field preparation)
- 13) Do you feel any positive effect of not having any livestock? (also in the field preparation)
- 14) Is there anything you would like to change/possible for you to change in your situation regarding land? (More machinery, cheaper fertilizer, more/less land, more livestock)
- 15) Do you think that your household will face any changes in the crop livestock situation in the future? (Positive/negative changes, more land, more livestock, changes in livestock or crop?)
- 16) Have you used more manure before, and if yes, what is the reason that you use less now?
- 17) How does manure change your crop yield?

### **Flow diagram**

Factors to be considered when doing the flow diagram:

Market, Kitchen, Mill, Neighbor

Crop: Rice, Cassava, Water Spinach, Bean, Banana, Watermelon, Grassland, Water resource

Livestock: Cow, Buffalo, Pig, Duck, Chicken

!: Women

+: men

For what purpose?

How?, what?

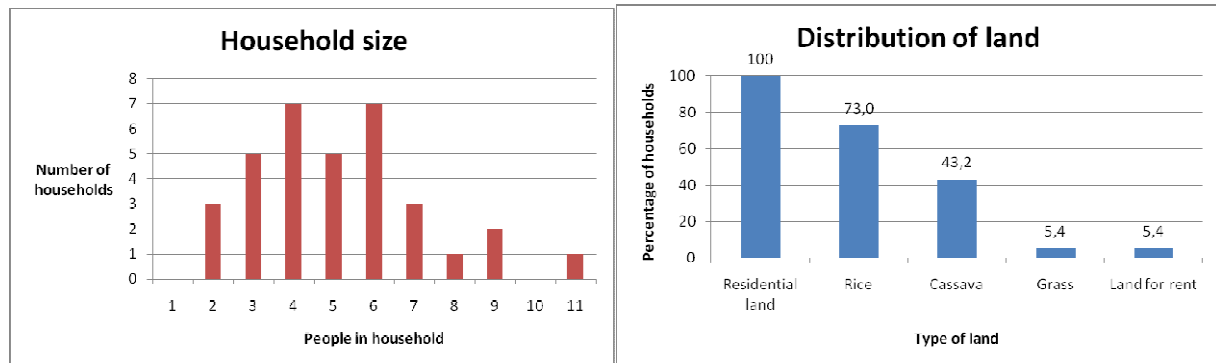
## Appendix 8

### General results from questionnaire

#### Village

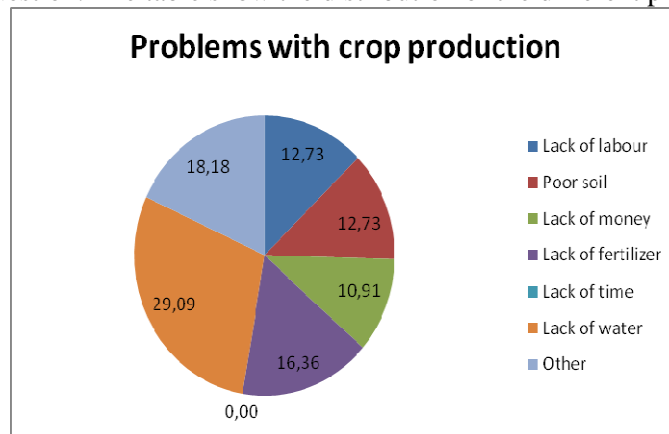
27% of the households in the survey were from the village Srash Chrey and 73% was from Banteay Chmar Tboung.

#### Household size



#### Problems

64.9 % of the households answered on whether they have problems with the production. Out of the 64.9 % all answered yes to the question. The table show the distribution of the different problems:

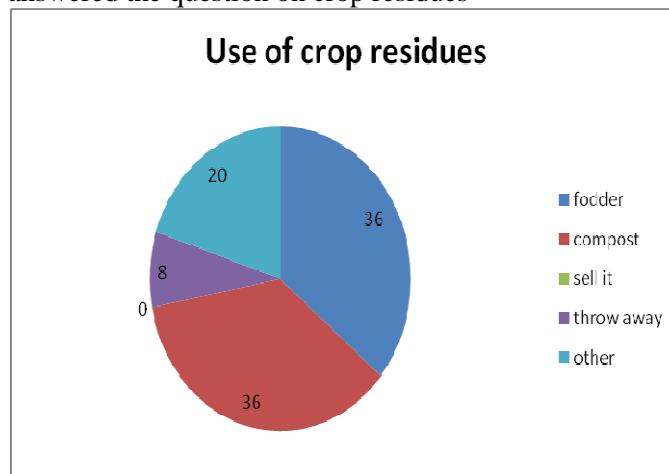


#### Pesticides

54 % of the survey answered on the question on pesticides. Out of these, 55 % are using pesticides on their fields whereas 45 % are not.

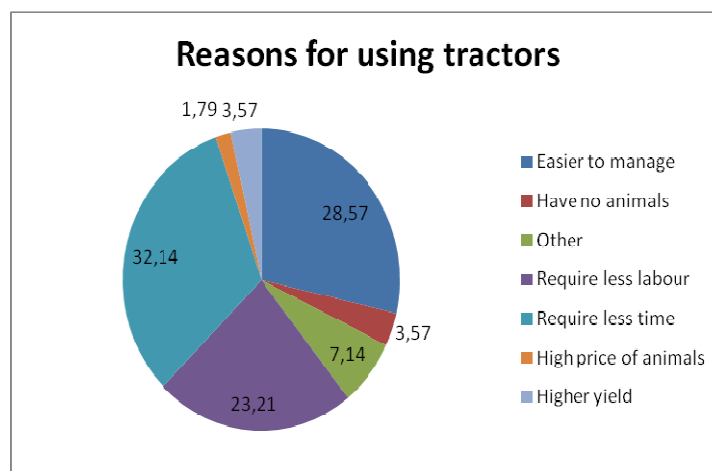
### Crop residues

67.6 % of the households answered the question on crop residues

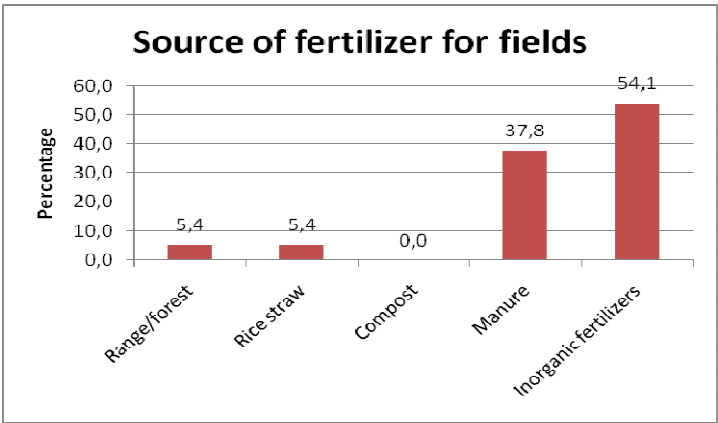


### Mechanicals

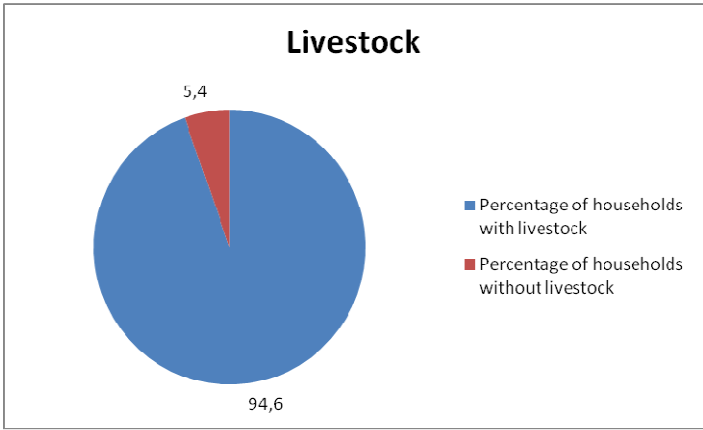
86.5 % of the household answered on the question on tractors. 81.3 % is using tractors on their field and 18.7 % are not. Out of the 18.7 % (6 households) that are not using tractors 2 households do not have any land, 1 only grow cassava and 1 rent a tractor from the neighbors. The last two households are not mentioning anything about tractors. They both have cows, but do not say anything about using them in the fields. The reasons for using tractors are given in the next table together with the percentages.



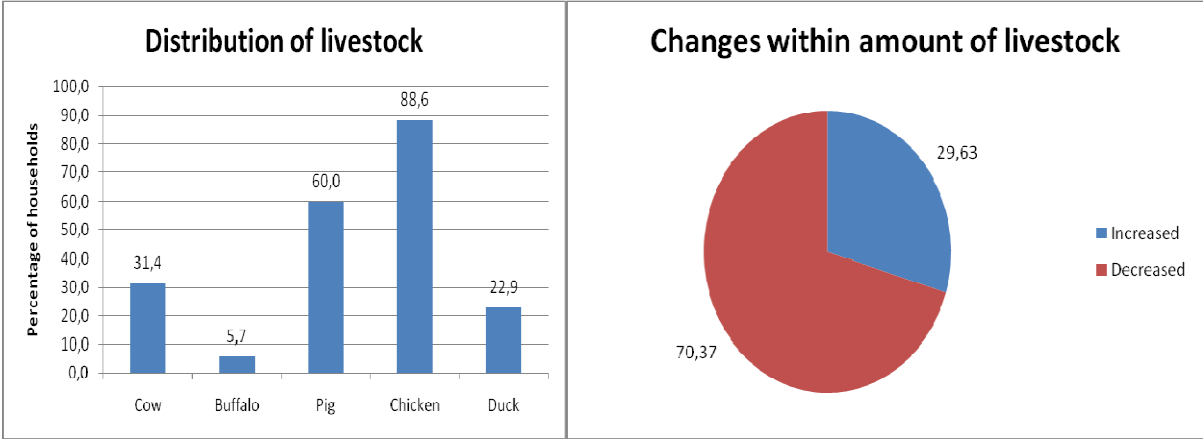
**Fertilizer**



**Livestock**

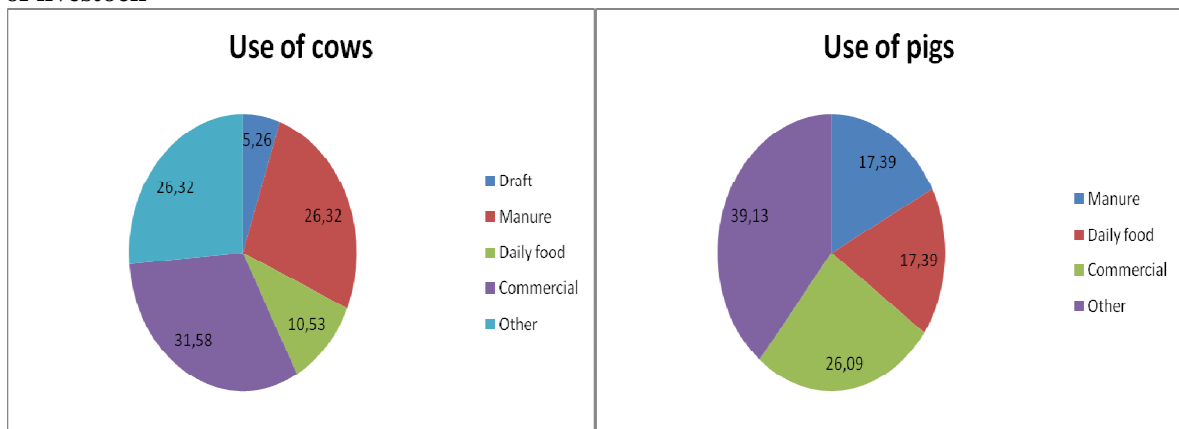


**Distribution of livestock**

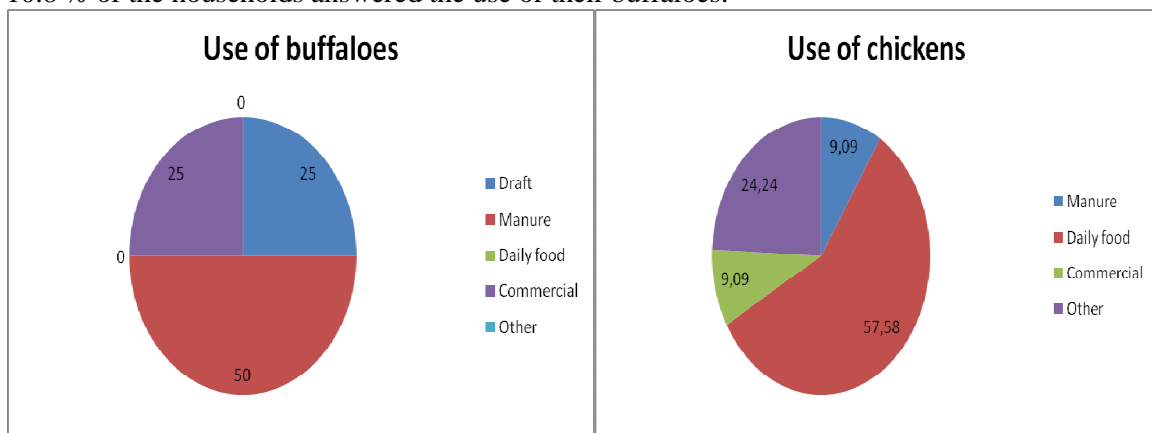


Household 28 have an increase in livestock because of more medicine and agricultural teaching whereas other households have had a decrease because of diseases.

## Use of livestock



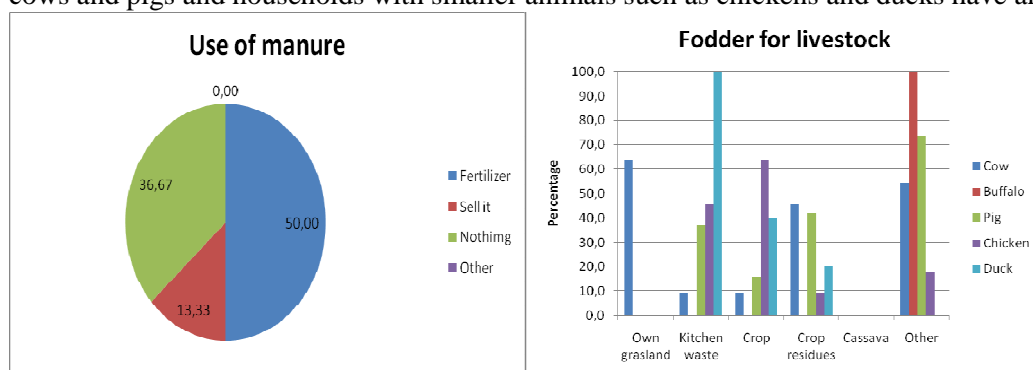
Only 10.8 % of the households answered the use of their buffaloes.



Only 4 households answered the question on what they are using the ducks for. All of them said that they are using them for daily consumption.

## Manure

81 % answered the question about use of manure, which means that both households with larger animals like cows and pigs and households with smaller animals such as chickens and ducks have answered.



**Animal health**

67.6 % of the households answered on the question on veterinary help. 76% said that they need veterinary help and 24 % answered that they do not need any help from the veterinary. 75 % percent said that they have had access to veterinary help whereas 25 % claimed that they do not have access. The 75 % of the households said that they do not have access because the veterinary and medicine is too expensive, while 25 % had other reasons for not having access.

One of the households only had poultry and therefore did not want to spend money on a veterinary. Some farmer is buying medicine for the animals on the market.

**Water management**

75.7 % answered the question on whether they had sufficient water. 60.7 % out of these said that they had enough water and 39.3 % said that they do not have enough.



## Appendix 9

### Explanation for calculating scores in land size

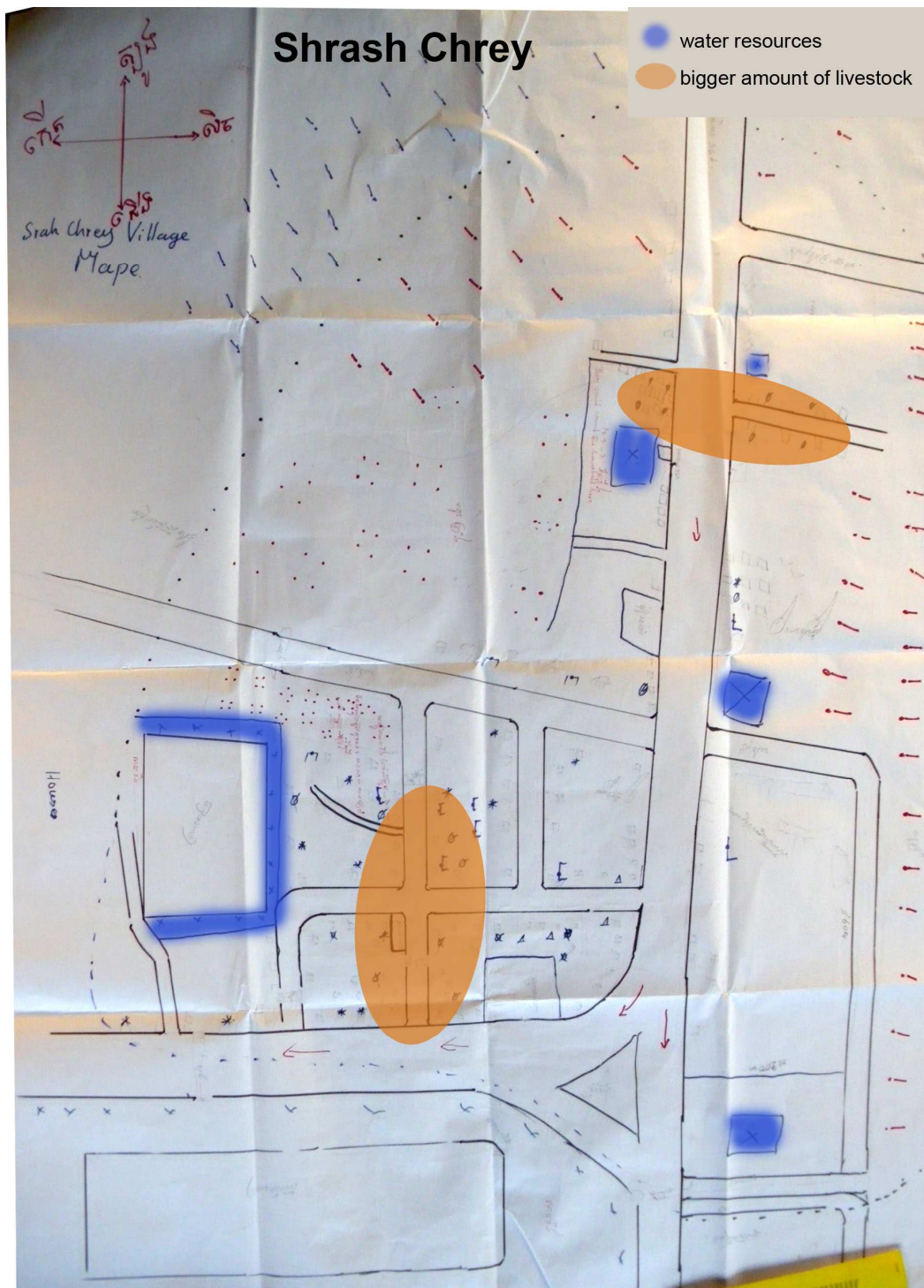
In the questionnaire we wanted to ask the respondents how much land they have. From the synopsis and after talking with our Cambodian counterparts we decided to divide the questions into different types of land; residential land, field land (rice), plantation land (cassava), grass land and land meant for renting out. We divided the answers into four categories; less than 0.5 ha, 0.5-1 ha, 1.1-3 ha and more than 3 ha. This division does not give a really precise number on the land area, and because of this we have decided to make a score system for the land sizes in order to use it for comparison. The score system is as follow:

Size of land plot	Written answer in questionnaire	Medium value	Score
No land	0	0	0
Less than 0.5 ha	1	0.25	1
0.5 – 1 ha	2	0.75	3
1.1 -3 ha	3	2	8
More than 3 ha	4	4.5	18

These score are based on the medium value for the different categories. The category “less than 0.5 ha” is used as the base and then the rest is chosen according to how many times bigger they are compared to 0,25 ha. The group “more than 3 ha” has an average value of 4.5 because the maximum plot size we have observed was 6 ha.

## Appendix 10

Village map made by group of farmers selected by village chiefs



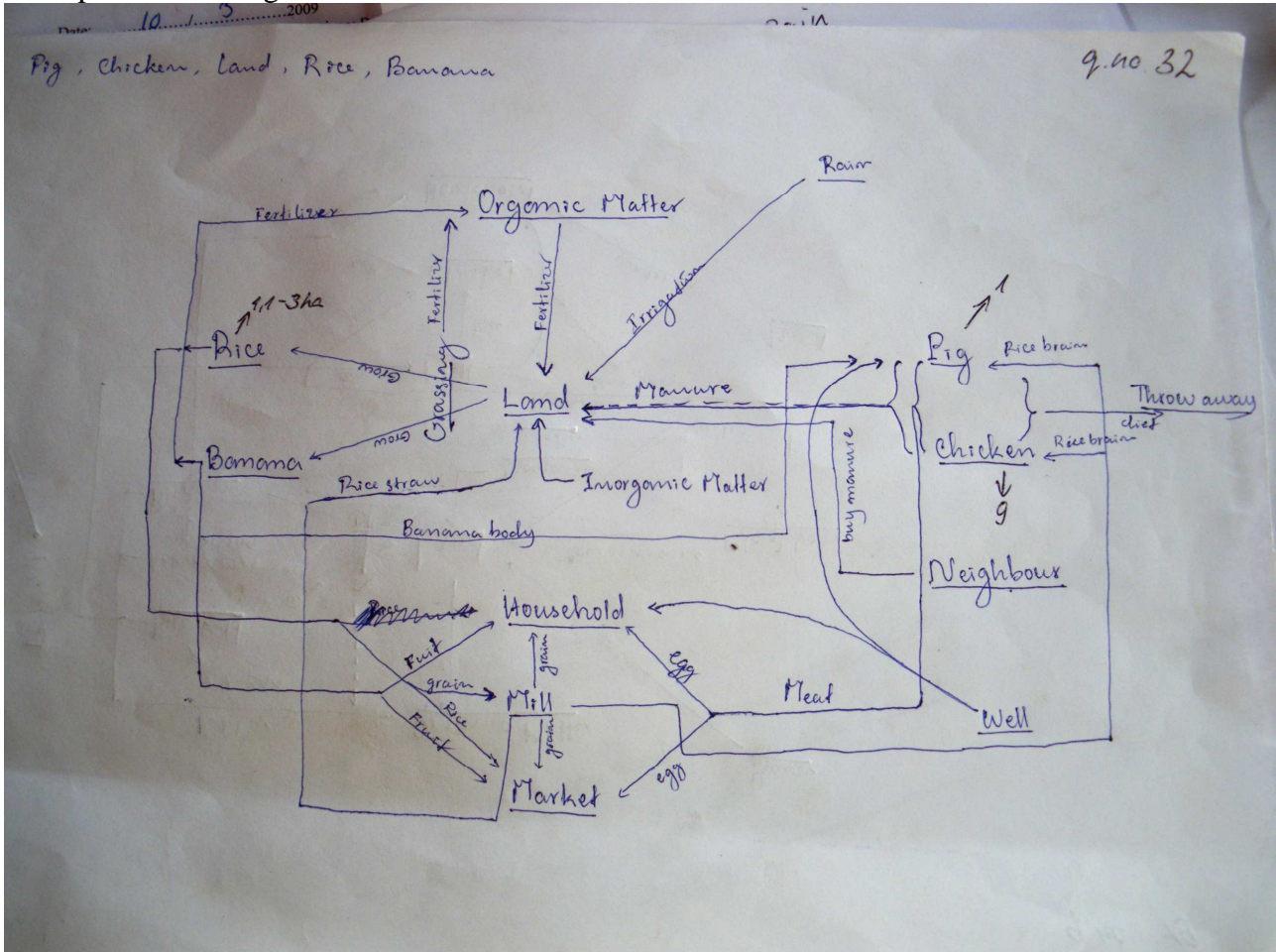
## Appendix 11

### Data overview

Data	Involved people/areas	Number of respondents
Questionnaires	Farmers living in Banteay Chhmar Tboung and Srash Chrey	37
SSI with key informants	The Commune Chief Village chief of Banteay Chhmar Tboung Village chief of Srash Chrey Two Agricultural extension officers from ECOSORN Veterinarian of Banteay Chhmar Tboung	6
SSI with farmers	9 farmers from the questionnaire survey and 2 farmers having a lot of cattle	11
Soil sampling	Field where no fertilizer is used Forest land Field applied with manure Field applied with inorganic fertilizer	4
PRA- Methods		
Flow diagram	Farmers used for SSI	9
Village mapping	Group of farmers (6-8) selected by village chief	2
Seasonal calendar	Group of farmers (6-8) selected by village chief	2
Ranking matrix	Group of farmers (6-8) selected by village chief	2

## Appendix 12

Example of flow diagram from farmers.



## **Appendix 13**

# **Synopsis**



## Synopsis

**The potentials and constraints for crop-livestock interaction in Bantaey Chhmar in the Bantaey Meanchey province, Cambodia.**



Department of Agricultural Sciences, Forest & Landscape, Faculty of Life Science,  
University of Copenhagen

**Thematic Course in Interdisciplinary Land Use and Natural Resource  
Management, SLUSE Field Course**

- 1. Submission 16<sup>th</sup> February 2009**
- 2. Submission 25<sup>th</sup> February 2009**

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## Table of content

1. Introduction	1
2. Hypotheses	2
3. Research questions	3
3.1 Main research question .....	3
3.2 Sub research questions .....	3
4. Methodology	4
5. Methods	4
6. References	7
Appendix 1	8
Appendix 2	10
Appendix 3	11
Appendix 4	15
Appendix 5	16
Appendix 6	20
Appendix 7	22

# 1. Introduction

## 1.1 Study site

The study site is in the commune Banteay Chhmar, situated 20 km east of the Thai border, in the northwestern Cambodian province, Banteay Meanchey. The province has an area of 6.679 km<sup>2</sup> and the total population is 586.571 out of which 28% and 72% of the population are living in urban and rural area respectively. Banteay Meanchey is defined as one of the poorest provinces in Cambodia with 31-50 % of the provincial inhabitants living below the poverty line<sup>2</sup> (SCW 2006; [www.fao.org/nr/water/aquqstat/countries/cambodia/index.stm](http://www.fao.org/nr/water/aquqstat/countries/cambodia/index.stm) cited in “Introduction to field sites in Cambodia” provided script in class, 2009).

The climate in Cambodia is mostly governed by monsoons and has two distinct seasons: wet and dry season. The average annual rainfall in Banteay Meanchey ranges from 1000 to 1500 mm and is the province in Cambodia with the lowest annual rainfall. The annual average temperature in Banteay Meanchey is between 26.8 - 27.1<sup>0</sup>C (UN [http:// world weather.wmo.int/145/c00347.htm](http://world.weather.wmo.int/145/c00347.htm) cited in provided script in class 2009).

## 1.2 Agriculture

Agriculture in Cambodia remains at a reasonably undeveloped state as farms are generally characterized by low input low output systems. Low input, the generally poor soil quality and the highly seasonal availability of water resources all contribute to comparatively low yields. The total population of Cambodia is 13.8 million out of which 9.6 million (69.3%) people are engaged in agriculture. The most important crop is rice, providing an estimated 70% of nutritional energy needs. Other important crops are maize, peanuts, sesame and soya. The soil of Banteay Chhmar is plinthite podzols - poor soil, therefore the soil has a low agricultural potential. Farmers of Banteay Chhmar are cultivating subsistence rain-fed rice, cassava and vegetables. Wet rice is grown once a year in the rainy season. Cassava is grown in secondary forest and the crop is only used for sale, not for consumption (FAO 2005; SCW 2006; UNDP 2004).

## 1.3 Livestock

In the recent years there has been an increase in livestock. This is mainly due to improved crop production and an increase in the general welfare of farmers. The key livestock of Cambodia is cattle (cows, oxen and buffaloes), pigs and poultry (chicken and ducks). Cattle are raised as draft animals for land preparation and soil conservation practices and in rural areas they are also used for transportation. Cattle are the most expensive livestock to purchase and are often bought when family income permits it and is therefore a mean of investment. In the recent years, draft cattle are in big parts of the rural areas, replaced with mechanical tractors for land preparation. Pigs are often used as a family cash enterprise. Richer families can have their own sow used for breeding, and families thereafter sell the piglets or fatten them in order to get more money.

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<sup>2</sup> The poverty line is set for 1.036 Riel in rural areas (SCW 2006).



Poor farmers without a sow, buy the young piglets, fatten them and sell them at the market when they have grown big. Banteay Chhmar is among the communes in Cambodia with the highest number of families with cattle and pigs (between 750 and 1.500 families for both) (student research themes for ILUNRM 2009). About 90 - 95% of the households in rural areas keep chicken. Poultry is often recognized as one of the few livestock assets for poor households. Chicken and eggs are important sources of protein in Cambodia and the chickens are therefore used for family consumption. When sold on the market, chicken gives just a small income, but since they are often fed on broken rice and walk free, it is an easy source of income. Ducks are raised mainly for eggs and are only kept in areas where farmers have good access to water (AgriSource 2004; Devendra and Thomas 2002; SCW 2006)

The most important problem of the livestock sector is animal disease. Hemorrhagic septicemia and foot and mouth disease is very common for cattle in Cambodia. Pigs can get swine fever and Newcastle disease and the avian flu is affecting the health of the poultry (OIE 2004 as cited in FAO 2005; SCW 2006). The Department of Animal Health and Production (DAHP) of Cambodia has insufficient skilled personnel, very few private veterinaries, lack of technical knowledge and lack of access to vaccines and drugs. The Government is investing in educating veterinaries but medicines are often still too expensive for farmers who cannot or will not pay medicine for their livestock (Ear 2005; FAO 2005).

#### **1.4 Crop-livestock interactions**

In Cambodia the dominant mixed (crop-livestock) farming system is rice based, whereby rice production is highly dependent on cattle and to lesser extent buffaloes for draft power and manure. In addition to the use of cattle as draft power there are other important links between livestock and crop production. The land used for agriculture and grassland is closely connected with livestock production and management in relation to fodder supply and nutrient efficiency in the soil. Farmers provide fodder according to the feed habit of livestock and the rice fields are often used for grassland after harvest. Crop-residues from the rice are used as fodder supply during the dry season. Although there is a growing tendency for farmers to apply commercial fertilizers on the field, manure can be applied directly to the fields as organic fertilizers. Dried animal manure or manure-based compost is an important and cheap way to sustain crop production systems (Devendra and Sevilla 2002; FAO 2005).

## **2. Hypotheses**

By making prediction on the answers to the research questions, we make hypotheses to see if there is correlation between our estimates and the investigation (see appendix 1). The hypotheses are meantime a justification for formulating the research questions as they are. Therefore the following part is our estimates

based on common knowledge, written literature and lectures from the course. This leads us to our main research question and thereby our sub research questions.

### 3. Research questions

#### 3.1 Main research question:

How to improve the role of livestock in the crop-livestock interaction?

#### 3.2 Sub research questions

- 1) What are the general potentials and constraints of livestock keeping?
- 2) What are the links between livestock and crop production?
- 3) What are the potentials of the crop-livestock interaction?
- 4) What are the constraints of the crop-livestock interaction?

In the **first sub research question** we want to find out what kind of livestock people are having and whether there is a link between the social status of a household and the amount and distribution of livestock. We want to identify what people believe to be the general constraints and potentials of livestock keeping.

The **second sub research question** is made in order to understand how livestock and crop are connected. We want to identify the links between crop and livestock in different households during the year.

The purposes of the **third and fourth sub research questions** are to investigate the constraints and potentials of the links between crop and livestock identified in sub research question two.

These four sub research questions lead to an answer on our main research question and helps give an estimate on how to improve the role of livestock in the crop-livestock interaction.

## **4. Methodology**

### **4.1 Research location**

The research will be conducted in the commune Banteay Chhmar in the Banteay Meanchey province in the North-west of Cambodia.

### **4.2 Research design**

The design of the study is shown in appendix 1 and the time schedule is given in appendix 2.**Error! Reference source not found.**

### **4.3 Brainstorm**

In order to get from the beginning thoughts to the research focus, we did a brainstorm and this is shown in appendix 7.

## **5. Methods**

In order to reduce bias, triangulation will be used on different subjects so that crosschecking can be done.

### **5.1 Sampling**

The target population for this study is farmers living in Banteay Chhmar. In order to get as reliable data as possible, households from different social levels will be involved as well as both people with and without land and livestock should be included. For some of the methods we use, the head of the household is asked, and for other methods we want to ensure that both women and men participate in order to reduce bias due to gender division.

### **5.2 Observations**

In order to reduce systematic bias from the data collected, observations are to be done continuously from the time of arrival to the time of departure, so that collected data can be compared with the observed situations.

### **5.3 GPS**

In order to get an overview of the area we will use GPS. This will be used to show the kind of land located near to the households at aerial photographs. It will also be used to measure the household's land area and therefore comparison of land areas is possible.

#### **5.4 Informal talk with key informant**

We are going to start off by having an informal talk with a key informant (village chief, NGO-person or agricultural extension officer) in order to get an overview of the village and our topic (see appendix 3 for interview guide line). The purpose of the informal talk is to select the target population for our questionnaire survey, to see whether our questionnaire should be edited and to get information on other possible key informants. The key informant will also be asked to make a seasonal activity calendar and a flow diagram of the general production system (see appendix 4) in order for us to have a better understanding of the different situations.

#### **5.5 Transect walk**

After speaking with a key informant we are going to do a transect walk across the area with the local person provided. The purpose of the transect walk is to get a physical overview of the village as well as to meet people in the village. The informal talk should have helped us to be more aware of what to observe when walking through the village.

#### **5.6 Questionnaire**

We will start by making a pre-test of the questionnaire on 1-2 farmers to assure its clarity, comprehensiveness and acceptability to the respondents (Rea and Parker 1997). Because of time limitation (edited) questionnaires (see appendix 5) will be applied to villagers in order to get quantitative information in a short time. At least 30 respondents will be chosen according to stratified simple random sampling in order to get households both with and without land and households with different social status. The questionnaires are used to identify what kind of livestock people have and what they use and need them for. The results are also going to show whether there is a link between their livestock and their crop system, and from which social status the household belong. By analyzing the data from the questionnaires we will divide the respondents into 3-4 strata according to their response. The strata will be defined based on the results from the questionnaires i.e. one strata where there are 3 links between their livestock and crop (manure, fodder and traction), one strata with 2 links and finally one strata with one or no links.

#### **5.7 Semi-structured interview with key informant**

After the questionnaires are analyzed, a semi-structured interview will be held with a key informant (see appendix 3 for interview guide line). This interview is conducted according to a flexible checklist or guide line and questions may be formulated based on the feedback from interviewees (Mikkelsen 2005).

We would like to talk to a veterinarian, an agricultural extension officer or a NGO-person. The purpose of this interview is to get information about the different strata identified in the

questionnaire analysis. This can help us to identify some of the constraints and potentials of the interaction between livestock and crop production. Because of the key informant's knowledge within this topic, we would also like to cover some future aspects, in order to try to get an understanding on how to improve the present situation.

## **5.8 Semi-structured interviews with farmers**

Within each of the defined groups from the questionnaire data analysis, 1-3 households will be chosen for semi-structured interview (see interview guide line in appendix 6). The purpose of the semi-structured interviews is to get in-depth information about the role of livestock in the crop-livestock interaction and which constraints and potentials there is linked to this interaction. The interviewed farmer will also be asked to do a seasonal activity calendar and a flow diagram (see appendix 4) of his/hers particular production system to see whether the constraints and potentials are connected with seasonality and/or the size/type of production system.

### **5.8.1 Soil sampling**

In order to measure whether the soil is affected by livestock keeping and thereby the use of manure, soil samples will be collected from different field areas. From the questionnaires we will find out who is using manure or fertilizer and who has not, and from that we are able to select the target households for the soil sampling. The samples will be collected while doing the semi-structured interviews.

## **5.9 Matrix Ranking**

In order to better understand the constraints of livestock keeping and the crop-livestock interaction, a matrix ranking will be made by two separate focus groups. The details are shown in appendix 4. Besides getting a better understanding of the constraints, the outcome of this PRA should hopefully lead to a discussion on how these constraints can be reduced.

Matrix ranking is a PRA tool which is defined by Robert Chamber in Asia Forest Network 2002:

“Participatory rural appraisal is a family of approaches and methods to enable local people to share, enhance, and analyze their knowledge of life and conditions, to plan, and to act.”

## 6. References

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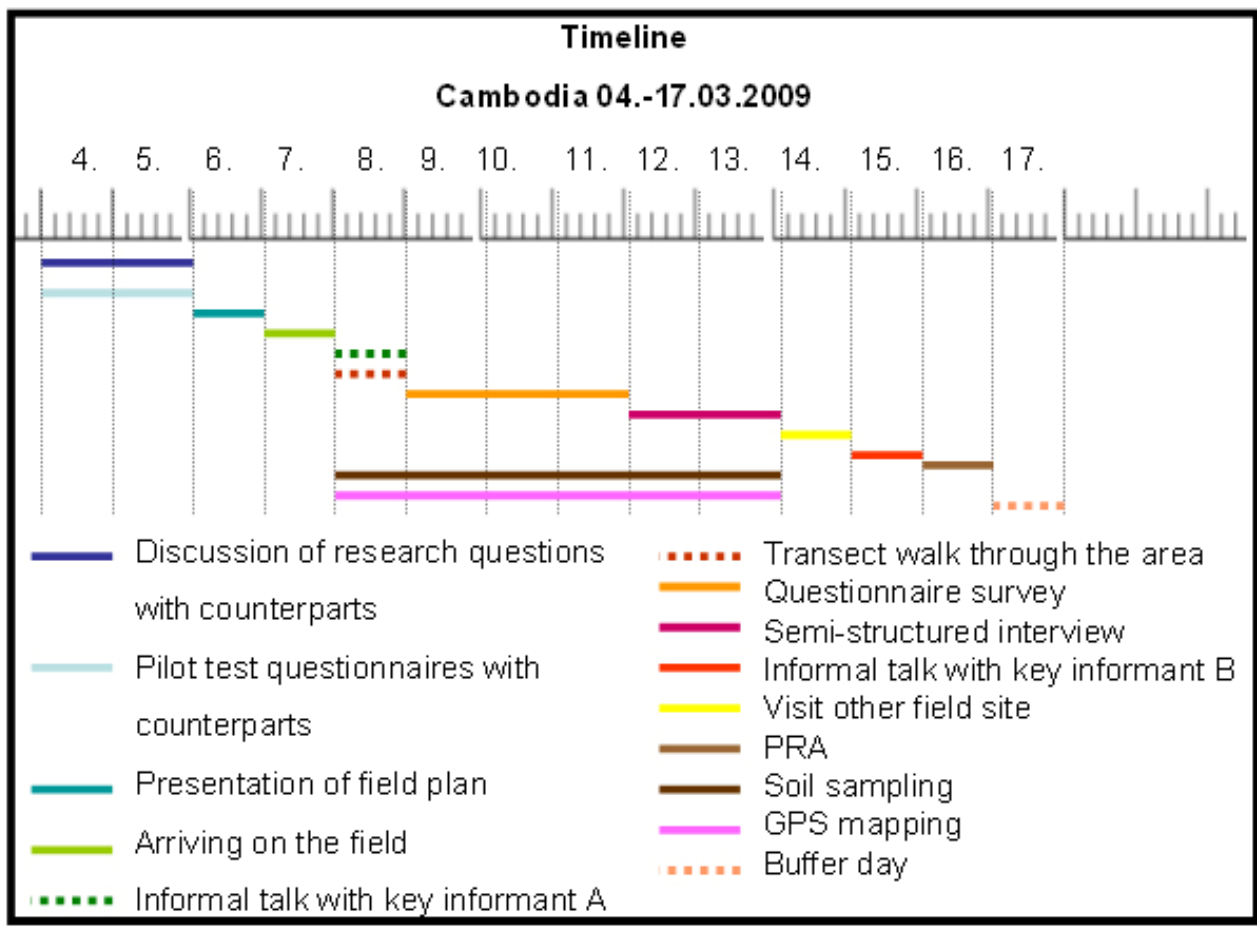
## Appendix 1

Subject	Objective	Hypothesis	Keywords	Data required	Proposed Methods
<b>Livestock keeping</b>	To identify the potentials and constraints of livestock keeping.	<p>Wealthy families have more livestock including more cattle or buffaloes whereas poorer families only have chicken, ducks and/or pigs.</p> <p>Poor people can have difficulties buying cattle.</p> <p>The small livestock are fed with whatever they can find, whereas cattle and buffaloes are grazing on public land/ fields and are fed crop residues during the dry season.</p> <p>Medicines for the livestock can be too expensive to buy.</p>	<p>Type of livestock</p> <p>Distribution</p> <p>Social status of family</p> <p>Fodder</p> <p>Medicine</p> <p>Use of livestock</p>	<p>Type of livestock</p> <p>Use of livestock</p> <p>Distribution</p> <p>Household size (adults/children)</p> <p>Household land area</p> <p>Type of fodder</p> <p>Needs/access to medicine</p> <p>Time for taking care of the livestock</p>	<p>Questionnaire</p> <p>Informal talk with key informant.</p> <p>Semi-structured interview</p> <p>Seasonal activities calendar</p> <p>Flow diagram of the production system</p> <p>Transect walk</p>
<b>Links between livestock and crop production</b>	To identify the links between livestock and crop production	<p>Cattle/buffaloes are used as draft animals on the fields.</p> <p>Rice residues are used as fodder in the dry season.</p> <p>Manure from the livestock (cattle) is used on the fields.</p> <p>The fields are used for grazing after harvest.</p>	<p>Draft</p> <p>Fodder</p> <p>Manure</p>	<p>Draft animal or tractor?</p> <p>Land use</p> <p>Manure/fertilizer?</p> <p>Seasonal fodder supply</p>	<p>Flow diagram of the production system</p> <p>Questionnaire</p> <p>Semi-structured interview</p> <p>Seasonal activities calendar</p>

<b>Constraints of crop livestock interaction</b>	To identify the constraints of the links between crop and livestock identified in research question number 2.	<p>If cattle/buffalo is sick then farmer cannot work if he has draft animals on the field.</p> <p>It is labour demanding operating land with draft animals.</p> <p>Manure managing is time consuming.</p> <p>Inadequate fodder leads to poor animal draft power</p>	<p>Disease</p> <p>Labour demanding</p> <p>Manure managing</p> <p>Inadequate fodder</p>	<p>Access to medicine</p> <p>Time for land preparation by draft/ tractor</p> <p>Type of manure used in field</p> <p>Time for managing the manure</p>	<p>Matrix ranking</p> <p>Semi-structured interview</p> <p>Interview with key informant</p>
<b>Potentials of crop livestock interaction</b>	To identify the potentials of the links between crop and livestock identified in research question number 2.	<p>The manure (from cattle) is a cheap and good way to fertilize the fields.</p> <p>The draft animals are a cheap and effective way to manage the fields.</p> <p>The crop residues from the fields can secure the fodder availability during the dry season.</p>	<p>Manure</p> <p>Draft</p> <p>Fodder</p>	<p>Manure managing</p> <p>Soil quality</p> <p>Draft animals/tractor</p> <p>Fodder availability</p>	<p>Matrix ranking</p> <p>Semi-structured interview</p> <p>Interview with key informant</p> <p>Soil sampling</p>



## Appendix 2



Because of time limitation in Cambodia the activities in the timeline are located compact. We only have one interpreter for the group, therefore splitting of the group is not possible when we need to understand what is said. After talking with the fellow students from Cambodia, this timeline might change because of changes in the research design or because we decide to split the group up, having people who speak Khmer in both groups.

In the mornings and daytime we are meeting with different local people and do other necessary outdoor activities. In the evenings we are going to analyze the data collected and plan the task for the next day, based on this timeline. Some activities will be done on the same day. GPS mapping and soil samples are taken on the days when we are on the fields, and data's are collected, in same time when we communicate with locals.

## Appendix 3

### A) Informal talk with key informant A

(village chief, NGO-person or agricultural extension officer. Village chief can provide us further information. When a disease break out the village chief has to inform the agricultural extension officer)

These questions might change after talk with Cambodian counterparts,  
How can we get in contact with the key informants?

*Presentation of yourself and the aim of the study*

- 24) Name, gender, age?
- 25) Working title/ position?
- 26) How long have you been living here?
- 27) Which animals are most common in Banteay Chhmar?
- 28) From where do people get their animals?
- 29) How are people managing their livestock? (Where and how)
- 30) Who is taking care/using the different livestock? (Gender, young/old)
- 31) How is the labour with cattle, pigs, poultry and ducks divided between women, men, children?
- 32) How many hours of work per day are related to each kind of animal?
- 33) What is the reason for people having these animals?
- 34) What are they using the animals for?
- 35) Is there any positive things related to keeping livestock? (Cattle as a cheap method for draft and manure fertilizer, crop residue as fodder security in dry season)
- 36) Is there any negative things related to keeping livestock? (Diseases, access to fodder, theft, illegal trading)
- 37) What types of diseases are common and for which livestock? (swine fever common on pigs, Avian influenza – bird flu, Foot mouth disease – common on cattle, bluetongue, black leg, Newcastle – poultry disease, Lumpy skin disease? – maybe cattle and pigs, Pasteurellosis - cattle)
- 38) What is the solution to this problem?
- 39) What kind of problems are linked with the fact that the Department of Animal Health and Production (DAHP) of Cambodia has insufficient skilled personnel, few private veterinaries, lack of technical knowledge and lack of access to vaccines and drugs?
- 40) What is the solution to this problem?
- 41) If the farmers cannot afford the vaccines and drugs the animals need, what is then the solution?
- 42) What is the alternative to keep livestock –if any?

43) What do you think will happen in the future with the livestock situation?

Are people going to have more/less livestock?

Is the distribution going to be different?

### **Crop production**

44) How many households have their own land? What is the common amount?

45) What are they using their land for? (Crop, grazing, cassava plantation, vegetables, forest plantation, household, other)

46) How are people managing the field?

47) Are they using draft animals or mechanical machinery? (Chemical or natural fertilizer)

48) How is manure from each animal used? (fresh, dried, compost)

49) What is the alternative to land use –if any?

50) Have you noticed a change in the land use during the last years?

51) How is the soil quality at the different fields?

52) Are there any possibilities on changing the quality of the soils?

53) Why do you think that there has been a change/that things remain the same?

54) Do you think that there will be a change in the future?

Change in crop?

More cultivated land?

More mechanical equipment?

Change in fertilizer?

55) Identify and characterize monthly and seasonal agricultural activities carried out in the village in livestock crop production during a year.

56) Make a flow diagram on the different components in a production system (livestock, manure, kitchen waste, crop and water)

57) Do you have any questions or comments?

*Thank you for your time and good bye*

*(More questions?)*

### **B) Semi-structured interview with key informant B**

(veterinarian, an agricultural extension officer or a NGO-person)

*These questions might change after talk with Cambodian counterparts, questionnaires, key informant information.*

*Presentation of yourself and the aim of the study*

46) Name, gender, age?

- 47) Working title/ position?
- 48) How long have you been living here?
- 49) What is the aim of your work here?
- 50) What are your thoughts on the future possibilities in this area?
- 51) How do you think it's possible to improve the livelihood and what impact does different trends have? (Importance of population, resource, national/international, governance and technological trends?)
- 52) How do you think it's possible to improve the livelihood capitals?
- 53) Is there any constraints related to the distribution of livestock? - What about the future?
- 54) What kind of problems are linked with the fact the Department of Animal Health and Production (DAHP) of Cambodia has insufficient skilled personnel, few private veterinaries, lack of technical knowledge and lack of access to vaccines and drugs?
- 55) What is the solution to this problem?
- 56) If the farmers cannot afford the vaccines and drugs the animals need, what is then the solution?
- 57) What are the future solutions on these problems?
- 58) Is there any constraints related to the distribution of crop production? - What about the future?
- 59) Is there any potentials/constraints related to the livestock crop interaction?
- 60) Do you have any questions or comments?

*Thank you for your time and good bye*

(More questions?)

### **C) Informal talk / Interview guide for semi-structured interview with farmer**

Based on answers from semi-structured interviews with key informant and questionnaires, we want to talk with 1-3 farmers within different strata separately. **These might be the questions we want to ask, but they might change after the first key informant interview and the questionnaires.**

*Presentation of yourself and the aim of the study*

- 1) Name, gender, age?
- 2) How long have you been living here?
- 3) Number of people in your household?
- 4) What is your occupation?
- 5) Which kind of livestock do you have? (Distribution)
- 6) What are you using the livestock for? (Draft, insurance, selling for money, consumption)
- 7) Who is taking care of the livestock?

- 8) How is the labour with cattle, pigs, poultry and ducks divided between the members of the household?
- 9) How many hours of work per day are related to each kind of animal?
- 10) What are you feeding your livestock? (Own / Public grass land, using other farmers fields, buying fodder, kitchen waste)
- 11) How easy/difficult is it to provide the correct fodder for your livestock?
- 12) Is there any positive things related to keeping livestock?
- 13) Is there any negative things related to keeping livestock? (Diseases, theft, access to fodder, low prices on market)
- 14) How much land do you have?
- 15) What are you using the land for?
- 16) Do you use traction power, draft, other?
- 17) How many hours a day do you use on land preparation by traction/draft?
- 18) How is manure from your animal used – if used? (fresh, dried, compost)
- 19) How much time do you use at managing the manure?
- 20) Are you selling products from the fields?
- 21) How is people's perception of the different livestock?
- 22) Is there anything you would like to change/possible for you to change in your situation regarding livestock and land? (More machinery, cheaper fertilizer, more/less land, more/less livestock)
- 23) Do you think that your household will face any changes in the livestock/crop situation in the future? Positive/negative changes, more land, more livestock, change in livestock or crop?
- 24) Identify and characterize monthly and seasonal agricultural activities carried out in your livestock crop production during a year
- 25) Make a flow diagram on the different components of your production system (livestock, manure, kitchen waste, crop and water)
- 26) Soil sampling from the fields

*Thank you for your time and good bye*

## **Appendix 4**

### **Flow diagram of the production system**

A flow diagram among different household is aiming at exploring relationships between various components of production system may be made on a large sheet of paper indicating the relationships by lines or arrows within and outside the farm (Selener et al. 1999). This will be done with special emphasis on the livestock and crop production system including their components manure, fodder, water, kitchen wastes. This might be helpful for searching visibly the type of components (For example, either their own fodder is used within their system or purchasing from outside the system i.e. market) are linked within or outside the farm.

The key informant will be asked to do a more general flow diagram, showing the general pattern of the different in and outputs.

### **Seasonal activities calendar**

Seasonal activities calendar will be applied to the interviewed person in order to categorize the responsibilities/activities according to season. These responsibilities/activities may include agriculture field preparation, cash and subsistence cropping, agri-crop harvesting, vegetables production, utilization of harvested material, manure supply to the field, fodder supply for livestock, livestock disease, crop disease, use of public land, grass production, livestock breeding and take care etc. in a year. We will use different colors of marker or paper for different season. This calendar can help us to evaluate land use during different season like wet, dry season based on their various activities which may for instance convey the message of fodder surplus or shortage. It can also reveal the link between crop and livestock according to seasonal activities (crop, livestock production, grass production) changes over the time.

The key informant will be asked to do a general picture of the shift in activities during the year.

### **Matrix Ranking**

Two focus group discussions will be held with the constraints within livestock keeping and crop-livestock interaction as topics. The people involved should be the head of different households with different status. All participants will be asked to identify the constraints within each of the two topics. The group will end up with 5-6 of the most important constraints and will thereafter be asked to rank these constraints. In order to compare the results from the ranking exercise with other data, each group member will be asked how much land and livestock the person has as well as number of people in the household. After ranking is finished the more prioritized constraints may be analyzed and aiming at the possible alternative solution for improvement of role of livestock in crop-livestock interaction can be found out.

## Appendix 5

### Questionnaire

Questionnaire number.....

Name of questioner .....

Interpreter.....

Date.....

Time.....

Name of area/village.....

**Make a circle around the right answer/s or write answers on the dotted line. Mark with one or more circle according to preference.**

**1. Name .....**

**2. Sex.....**

**3. How old are you? .....**

**4. Occupation? .....**

**5. How many people are living in your household .....**

**6. Who is the head of the household?**

a) Man

b) Woman

**7. Fill in the types of land you own**

a) Home garden

b) Subsistence crop land

c) Cash crop land

d) Grassland

e) Other .....

**8. How big is your land?**

a) I do not have any land

b) Less than 0,5 ha

c) 0,5 - 1 ha

d) 1,1 - 5 ha

e) More than 5 ha

**9. Livestock**

**I. What kind of livestock you have?**

**Write the number**

- a) Pig.....
- b) Oxen.....
- c) Buffalo.....
- d) Cow .....
- e) Chicken.....
- f) Duck.....
- g) Other . . . . .

**10. Cattle**

**I. If you have cattle, what is their purpose?**

- a) Consumption
- b) Draft animal
- c) Manure
- d) Producing milk
- e) Selling milk
- f) To sell/trade
- g) Other . . . . .

**II. And if you use their manure, for what purpose then?**

- a) Crop production
- b) Garden
- c) Selling
- d) Burning for cooking
- e) Other.....

**III. What are you feeding the cattle?**

- a) own grassland
- b) public grassland
- c) kitchen waste
- d) crop
- e) crop residues



- f) cassava
- g) other.....

## **11. Poultry**

### **I. If you have poultry, what is their purpose?**

- a) Consumption
- b) Manure
- c) Producing eggs
- d) To sell/trade
- e) Other . . . . .

### **II. And if you use their manure, for what purpose then?**

- a) Crop production
- b) Garden
- c) Selling
- d) Other.....

### **IV. What are you feeding the poultry?**

- h) own grassland
- i) kitchen waste
- j) crop
- k) crop residues
- l) cassava
- m) other.....

## **12. Pigs**

### **I. If you have pigs, when what are their purpose?**

- a) Consumption
- b) Manure
- c) To sell/trade
- d) Other . . . . .

### **II. And if you use their manure, for what purpose then?**

- a) Crop production
- b) Garden

- c) Selling
- d) Other.....

**III. What are you feeding the pigs?**

- a) own grassland
- b) kitchen waste
- c) crop
- d) crop residues
- e) cassava
- f) other.....

**13. Veterinary help**

**I. Do you sometimes need to use veterinary help?**

- a) Yes
- b) No

**II. If you don't have access for veterinary, what is the reason?**

- a) Too expensive
- b) Don't have veterinary doctor on the area
- c) Other . . . . .

THANK YOU FOR ANSWERING!

## Appendix 6

### Informal talk / Interview guide for semi-structured interview with farmer

Based on answers from semi-structured interviews with key informant and questionnaires, we want to talk with 1-3 farmers within different strata separately. **These might be the questions we want to ask, but they will change after the first key informant interview and the questionnaires.**

#### *Presentation of yourself and the aim of the study*

27) Name, gender, age?

28) How long have you been living here?

29) Number of people in your household?

30) What is your occupation?

31) Which kind of livestock do you have?

(Distribution)

32) What are you using the livestock for?

(Draft, insurance, selling for money, consumption)

33) Who is taking care of the livestock?

34) How is the labour with cattle, pigs, poultry and ducks divided between the members of the household?

35) How many hours of work per day are related to each kind of animal?

36) What are you feeding your livestock?

(Own / Public grass land, using other farmers fields, buying fodder, kitchen waste)

37) How easy/difficult is it to provide the correct fodder for your livestock?

38) Is there any positive things related to keeping livestock?

39) Is there any negative things related to keeping livestock?

(Diseases, theft, access to fodder, low prices on market)

40) How much land do you have?

41) What are you using the land for?

42) Do you use traction power, draft, other?

43) How many hours a day do you use on land preparation by traction/draft?

44) How is manure from your animal used – if used?

(fresh, dried, compost)

45) How much time do you use at managing the manure?

46) Are you selling products from the fields?

47) How is people's perception of the different livestock?

48) Is there anything you would like to change/possible for you to change in your situation regarding livestock and land?

(More machinery, cheaper fertilizer, more/less land, more/less livestock)

49) Do you think that your household will face any changes in the livestock/crop situation in the future?

Positive/negative changes, more land, more livestock, change in livestock or crop?

50) Identify and characterize monthly and seasonal agricultural activities carried out in your livestock crop production during a year

51) Make a flow diagram on the different components of your production system

(livestock, manure, kitchen waste, crop and water)

52) Soil sampling from the fields

*Thank you for your time and good bye*

## Appendix 7

### Brainstorm

#### Livestock – crop interaction

##### Labour:

Crop  
Livestock  
Gender  
Seasonality  
Income  
time

##### Crops:

Species  
Production  
Seasonality  
Management  
Distribution  
Consumption  
uses

##### Trade:

Diseases  
Transport  
Income  
Import  
Export  
Market access  
illegal

##### Disease:

Imports  
Exports  
Death rates  
veterinary

##### Social factors:

Distribution  
Security  
Status  
Gender

##### Livestock:

Species  
Production  
Multiplicity  
Management  
Distribution (numbers, dif.  
Species)  
Draft  
Consumption  
Theft  
Insurance  
Investment

##### Land-use:

Crops  
Seasonality  
Grassland  
Cultivation  
Fertilizer (manure)  
Manure  
Input/output  
Labour demand (manure)

##### Fodder:

Seasonality  
Crop Residues  
Own fodder?  
Cassava