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Fakulteten för veterinärmedicin och husdjursvetenskap

Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and Animal Science

Improvement in agricultural production in a rural area of Cambodia between 2004 and 2011 – with an emphasis on small scale cattle production



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Förbättringar inom jordbruksproduktion på landsbygden i Kambodja mellan 2004 och 2011 – med tyngdpunkt på småskalig nötproduktion

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I would like to dedicate this report to the memory of Urban Edblad.

Sammanfattning

Kambodja ligger i sydöstra Asien med ett tropiskt monsunklimat och distinkta regn- och torrperioder. Fattigdom är ett stort problem i Kambodja och enligt en undersökning gjord 2009 lider 30 procent av befolkningen av fattigdom. Runt 80 procent av Kambodjas befolkning bor på landsbygden där fattigdom är ett ännu större problem än i städerna. Inom jordbruket är risodling den dominerande grödan och ris odlas på 85 procent av landets odlingsbara mark. Inom det kambodjanska jordbruket hålls även gris, fjäderfä och nötkreatur. Under 2011 utfördes en fältstudie på landsbygden i Kambodja. Studien var finansierad av SIDA och genomfördes i samarbete mellan organisationen CelAgrid och SLU. Syftet med studien var att utvärdera flera projekt som implementerats av CelAgrid i ett område mellan åren 2004 och 2011. Projektens huvudsakliga mål var att öka och stabilisera hushållens inkomster samt försörjning av säkra och näringsriktiga livsmedel. Att öka djurväl-färden och kunskapen hos lantbrukarna ingick också som en del i projekten. En sammantagen utvärdering av projekten gjordes med fokus på småskalig nötproduktion. Förutsättningar samt förbättringar inom nötproduktion undersöktes. Studien innehöll en teoretisk och en praktisk del. Den praktiska delen genomfördes i fem olika byar på landsbygden där 25 hushåll deltog. I en av byarna, Sras Takoun, användes metodiken PRA och slutsatserna från studien kommer att kommuniceras tillbaka till deltagarna som en del av PRA-metoden. Resultaten visar att CelAgrids insatser har varit positiva eftersom både inkomstnivåer och livsmedelssäkerheten har förbättrats. Projekten har också bidragit till förbättringar inom nötproduktion och djurhälsa även om det fortfarande förekom vissa problem som sjukdomar och brist på foder inom produktionen.

Abstract

Cambodia is located in Southeast Asia with a tropical monsoon climate and distinctive wet and dry seasons. Poverty is a widespread problem in Cambodia and 30 percent of the population were classified as poor in 2009. About 80 percent of the populations live in rural areas where poverty is an even greater problem. In agriculture, rice cultivation is dominating and the crop is cultivated on 85 percent of the arable land. Livestock keeping is also a traditional part of Cambodian agriculture. In 2011, a minor field study founded by SIDA was performed in a rural area of Cambodia. This was done in collaboration between the organization CelAgrid and SLU. The purpose of the study was to evaluate several projects implemented in the area by CelAgrid between 2004 and 2011. The main objectives of the projects were to achieve improved and sustainable income levels and food security in the rural households. Improving animal health and education of the farmers were also comprised in the project objectives. An overall evaluation of the interventions was done with a focus on small-scale cattle production. Conditions and improvement in cattle production was investigated. The study contained both theoretical and practical parts. The practical part was performed in 25 rural households in five villages in Takeo province. The methodology of PRA was used in one village, Sras Takoun. As a part of PRA, the conclusions of the study will be communicated back to the participants. The results conclude that interventions made by the projects had been successful and that income levels and food security had been improved. Animal production and health had also improved during the project period; however problems with diseases and lack of feed still exist within the production.

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Preface

This bachelor thesis was performed as a Minor Field Study (MFS) in rural areas of Cambodia funded by a scholarship from the Swedish International Development Cooperation Agency (SIDA). The project was accomplished in collaboration between the Centre for Livestock and Agriculture Development (CelAgrid) and the Swedish University of Agricultural Sciences (SLU). The MFS was performed during two months in spring 2011. Initially, the main purpose was to evaluate the contributions done by the earlier implemented project “*Integrated development approach toward sustainable food security and income of farming communities*” (Borin, 2009). However, it turned out to be several projects connected to the first and therefore these projects were also included in an overall evaluation. The practical parts were performed in Takeo province, Sanlong commune while the theoretical part was done at CelAgrid’s office in Phnom Penh. The present report focuses on small scale cattle production in rural areas in Cambodia, but also includes general results and analysis from the field study. For further reading about the area, see Emilia Wallberg’s (2011) report about “*Small scale pig production in Takeo province in a rural area of Cambodia*” (<http://epsilon.slu.se>).

Introduction

The Kingdom of Cambodia is situated in Southeast Asia and border to Vietnam, Laos and Thailand. Cambodia has a tropical monsoon climate with temperatures between 21 and 35 °C and a precipitation of 1400 -5000 mm rain per year depending on location. The air humidity is high during the wet season that last from May until October and lower during the dry season between November and the middle of March (Marklund, 1990). In 2011, the World Bank (WB) estimated the population in Cambodia to 14.31 million people (WB, 2013). The capital, Phnom Penh, has around 1.5 million inhabitants (SIDA, 2009). The majority of the Cambodian people belong to the ethnic group Khmer and about 80 percent of the population lives in rural areas (SIDA, 2009; WB, 2013).

Integrated small-scale farming with crop and livestock keeping is the main agricultural production system used in Asia (Devendra & Thomas, 2002). Devendra (1993) defined small scale farming as “complex interrelationships between animals, crops and farming families, involving small land holdings and minimum resources of labour and capital, from which small farmers may or may not be able to derive a regular and adequate supply of food or an acceptable income and standard of living”. Traditionally, the Khmer people are rice farmers combined with livestock keeping. Thus, more than 85 percent of the arable land in Cambodia is used for rice production. Other common occupations are vegetable farming, fishing and handicraft (Marklund, 1990). The income level in Cambodia is classified as low, and poverty is a widespread problem. According to the national poverty line in 2009, approximately 30 percent of the population was considered poor. In rural areas, the poverty ratio is even higher. In 2011, the gross domestic product (GDP) in Cambodia was 897 US dollar per capita where agriculture contributed with 37 percent of the total GDP (WB, 2013). Thus, agriculture account for a substantial part of the Cambodian economy. As a comparison, Sweden had a GDP per capita of 57 091 US dollar in 2011 and agriculture contributed with two percent of the total GDP in 2010 (WB, 2013).

The Centre for Livestock and Agriculture Development (CelAgrid) is a non-governmental organization that was founded in 2003 (CelAgrid¹, 2012). The organization cooperates with several universities, institutes and organizations involved in agriculture. Several funders such as Heifer Project International-Cambodia (HPI-KH), Food and Agriculture Organization of

the United Nations (FAO) and Telefood Project finance CelAgrid's work by donations (CelAgrid², 2012). Since 2004, several projects have been initiated in Takeo province, Sanlong commune by CelAgrid in cooperation with different donors. Consistently for all projects, the purpose was to stabilize income levels and improve food security for rural households in the area (Borin, 2011). Food security was defined by the World Food Summit (WFS) in 1996. The concept of food security refers to all people having access to safe, sufficient and nutritious food at all time, in order to have a healthy and active life. Thus, the concept of food security includes both availability and accessibility of food. Physical and economic access to food together with nutritional needs and food preferences need to be regarded in the concept of food security (WHO, 2012). Also, CelAgrid has stated that safe food implicate food without chemical, microbial or physical contamination throughout the entire food production chain (Borin Khieu. Director of CelAgrid. Personal communication, 2011).

In 2005, CelAgrid initiated a project in Takeo province with the purpose to improve nutrition and overall living conditions in the targeted area. Contributions such as cows, biodigesters, vegetable seed and seedlings were provided to the participating households. Also, the concept of "Passing On the Gift" (POG) was introduced, where the offspring of the contributed animals would be given to another family in the community (Borin, 2005). Furthermore, in 2006, another project was initiated by CelAgrid in the same villages and one additional village. The objectives were to improve productivity of each farm and decrease dependence from external inputs. Inputs such as piglets, material for pig pens, fingerlings and plastic sheet for fish ponds were contributed, however no cattle were provided through this project (Borin, 2007). In 2009, the project "*Integrated development approach toward sustainable food security and income of farming communities*" was initiated in previously targeted villages and in four other villages (Borin, 2009). Initially, the aim with the present bachelor thesis was to perform a survey of the progress achieved by this project alone. However, as several connected projects had been implemented in the area by CelAgrid, the entire period from 2004 until 2011 was evaluated. Thus, the purpose was to investigate what general impressions, both advantages and shortages, CelAgrid's projects had resulted in for the designated households.

Background

Small scale cattle production

In Cambodia, cattle are a valuable resource in the rural household and predominantly used for draught power with meat production considered secondary (Maclean, 1998). In 2011, the number of cattle in Cambodia was approximately 3.4 million (MAFF, 2012). The average number of cattle owned in Cambodia is two heads per household (Maclean, 1998). In villages classified as high intervention villages, the number of cattle has shown to be higher than in low intervention villages (Nampanya *et al.*, 2012). Cattle are an economic resource with individual value and the profit of an adult animal sold can cover the loss of an entire wet season rice crop. However, factors such as nutrition, health control, seasonal conditions and marketing are factors that will influence the profitability of keeping cattle (Maclean, 1998). In 2010, the consumption of bovine meat in Cambodia was approximately 5.4 kilogram per capita (FAOSTAT, 2013).

Three different cattle breeds are used in Cambodia; "*gor srok*" or local cattle and two *Bos indicus* breeds, Haryana and Brahman. The local cattle are early maturing, small-sized

animals with a mature weight around 250-350 kilogram. This breed have low feeding requirement for maintenance and calves can be produced despite limited feed availability. Thus, the local cattle are well adapted to the conditions in rice producing areas. The Haryana is suitable for draught since it is narrow-shouldered and tall. Compared to the local cattle, the Haryana is later maturing and has a mature weight around 400-500 kilograms. The feeding requirement for maintenance is also higher. Crossbreeds between local cattle and Haryana are commonly used to get stronger and larger cattle. However, both purebred Haryana and crossbreeds require better nutritional conditions and are preferably used in riverbank areas (Maclean, 1998).

In Cambodia, cattle are kept differently depending on purpose of the particular animal. Several housing alternatives are common, and might differ depending on season. The feeding management is also determined by such factors as purpose of the cattle and season. However, the feeding of cattle in Cambodia mainly implies feeding whatever available at the time and not according to the animal requirements. Working animals used in crop cultivation are kept at the house, predominantly fed with rice straw. Cattle can also be moved to the fields during the day to graze and returned to the house in the afternoon (Maclean, 1998).

In Asia, agricultural production predominantly consists of multiple cropping systems with rice and wheat production (Devendra & Thomas, 2002). Rice straw is a by-product from rice cultivation and the main feed component for ruminants in developing countries (McDonald *et al.*, 2011; Leng 1997). The digestibility of rice straw is higher for the stem than the leaves and the content of ash in rice straw is very high compared to other straws (McDonald *et al.*, 2011). In Cambodia, the second most important crop cultivated after rice is cassava (Sopheap *et al.*, 2012). The metabolisable energy (ME) and protein content is higher for cassava tubers than for rice straw (McDonald *et al.*, 2011). Grass is another common feed resource, provided either by pasture or cut (Leng, 1997). During wet season, cattle are allowed to graze freely during daytime (Maclean, 1998).

Prevention of animal health

Foot and Mouth disease (FMD) is an endemic, viral disease occurring in cattle in Cambodia. Symptoms of the infected animal are blisters, salivation, sore feet and lameness. Also, bacterial infection can be a secondary disease problem due to blisters that burst resulting in wounds. The way of infection of FMD is by transfer through contact between the infected animal and non-infected animals. The disease has a relatively low death rate, however FMD outbreaks is connected to economic losses since the animals are unable to work and eat while infected. Though, FMD can be prevented by vaccination. Other diseases occurring in cattle in Cambodia are; haemorrhagic septicaemia, anthrax and blackleg (Maclean, 1998).

The Department of Animal Health and Production (DAHP) is a division under the Cambodian Ministry of Agriculture, Forestry and Fisheries (MAFF) (MAFF, 2010). The ministry work towards increased food security and sustainable development where DAHP is responsible for issues concerning animal welfare (MAFF, 2010; Peda, 2011). The operation range of DAHP covers vaccination programmes, monitoring severe disease outbreaks and preventing illegal acts of animal welfare such as illegal transportation of animals (Peda, 2011).

A new law concerning animal health, welfare and production is under revision and will hopefully be implemented during 2013. All animals used in animal production will be

covered in the new law together with subjects on veterinary medicine and animal nutrition (Peda, 2011).

Veterinarian services

Different levels of veterinarian services are available in rural areas of Cambodia. Veterinarians are divided into three categories; village, district, and province veterinarians depending on the level of education. Village veterinarians or more correctly referred to as Villager Animal Health Workers (VAHW), possess basic knowledge of animal health and receive a month of theoretical training and an optional practical part. Procedures such as deworming, castrations and vaccinations can be performed by VAHWs but not more advanced operations such as surgery. Other fields of responsibility for VAHWs are to produce monthly reports to the district veterinarian of the animal health status in the villages. To become a district veterinarian, three years of education is required. In Cambodia, province veterinarians are the only ones with a complete veterinarian education including six years of theoretical studies. Provincial veterinarians are responsible for monitoring severe disease outbreaks in the villages in cooperation with DAPH (Peda, 2011).

Vaccination

In Cambodia, DAPH are responsible for the national vaccination policy, also referred to as vaccination programme. Within the programme, vaccine against hog cholera (HC) is provided to farmers free of charge. Vaccine against FMD would be desirable, however, it is considered too expensive. Vaccinations are performed in the villages by volunteers in collaboration with the district veterinarian (Peda, 2011).

There is a big problem in Cambodia with people opposing against vaccination of animals. The main reason is that people do not believe in the effect of vaccines. Explanations for this phenomenon could be poorly performed vaccinations caused by inexperienced volunteers, not properly storage of the vaccine or lack in quality of the vaccine (Peda, 2011).

Development projects in the area

Since 2004, CelAgrid has initiated several projects in cooperation with HPI-KH, FAO, Mekong Basin Animal Research Network (MEKARN) and SIDA among others in Takeo province, Sanlong commune, Cambodia (Borin, 2011).

In 2005, a project financed by HPI-KH was initiated in Takeo province in collaboration with CelAgrid and three villages in Treang district were comprised. The project aspired to women headed households and supplied each participating household with one cow, one biodigester, vegetable seed and seedlings. In addition, each participant received non-formal trainings in vegetable growing, production and animal health. Also, three people per village were elected to function as VAHW in order to improve animal health further. Together, these interventions aimed to improve families' nutrition and overall living conditions in the targeted area. The vision was that the participants should use POG (Borin, 2005). Thus, the project would spread without any additional input.

In 2006, CelAgrid introduced the Telefood project "*Integration farming system approach to maximize return for the rural community of Treang district, Takeo province, Cambodia*" in the concurrent villages and in one additional village. The project objectives were to improve productivity of each farm and decrease dependence from external inputs. The project also

aspired to women headed households and provided the ongoing HPI-KH project with supplementary inputs. However, no cattle were contributed, instead additional inputs such as piglets, material for pig pens, fingerlings and plastic sheet for fish ponds were provided (Borin, 2007). Further, the project “*Integrated development approach toward sustainable food security and income of farming communities*” was initiated in 2009 in the already participating villages and in four additional villages. The main objectives of the project were to increase food security and income by improving the micro-ecosystem in Sanlong and Ang Keo commune. This was achieved by rehabilitation of water supply infrastructure and reforestation. The project was financed by the Global Environment Facility/Small Grants Programme (GEF/SGP) (Borin, 2009).

Material and methods

The study was performed in rural areas of Takeo province, at the end of the dry season. Impacts of the project “*Integrated development approach toward sustainable food security and income of farming communities*” (Borin, 2009) together with the coordinated HPI-KH and Telefood projects were evaluated. Five villages were participating in the study; Sras Takoun, Krom, Louk, Ang Taphouk and Krang Thnort. All villages were visited during the practical part of the field study. Both questionnaires and Participatory Rural Appraisal (PRA-) methods were used in order to evaluate general impacts from the implemented projects done by CelAgrid. The following aspects were investigated:

- Agriculture production
- Type of livestock at present (2011), and before the project was initiated (2004)
- Impacts of project objectives
- Further needed improvements
- Economic consequences
- Possible changes in life quality

In order to get a general idea of the situation in rural areas of Cambodia, a visit to the village Sras Takoun was arranged at the initial stage of the project. Information provided by the farmers as well as CelAgrid’s staff, together with own observations functioned as a basis for the questionnaires.

Questionnaires

The questionnaires (Appendix 1) contained four different subdivisions; general questions concerning the family, and specific questions concerning cattle-, pig and fish production. In appendix 1, the general part and the part concerning cattle production is included since the report focus on cattle production. Aspects as annual income, food security and further impacts were comprised in the general part.

Together with two interpreters, Keo Sath and Huy Sokchea, interviews were performed in the five participating villages with the questionnaires as a base. In total, 25 farmers answered the questions in the questionnaires, as five households were interviewed in each village.

Participatory Rural Appraisal method

Methods included in PRA constitutes of three main parts; methods, behaviour and attitudes, and sharing. The purpose is to combine these three components in order to investigate local

circumstances of life. The methodology of PRA is performed in small groups consisting of local people where the participants often represent poor and marginalised groups. The PRA-method is both visual and palpable. It also includes the use of many different tools. Different types of diagrams and maps are used within the PRA-method but also timelines, rankings and piling of objects. The tools are often performed on the ground with the usage of local substrates such as stones, sand, seed or charcoal. Different objects are used as symbols representing different aspects of the participant's situation in life such as indicating characteristics, mobility or resource availability (Chambers, 2007).

After compilation of the questionnaires and with these results as a basis, the PRA-methods were outlined. Inputs from the local staff and project information were also used throughout this process. The PRA-methods were only performed in one village, Sras Takoun. Six different methods were used and the number of participants differed between exercises. However, at least ten different families were involved in the activities. Beside the village participants, the PRA-team consisted of two bachelor degree students from SLU as well as two interpreters.

Village mapping

In order to create a map over Sras Takoun (Appendix 2), an already existing village map was copied by a number of village members together with one of CelAgrid's local staff. The map had been part of a similar study performed earlier in the village. The number of participants varied throughout this exercise due to modifications in the group during the ongoing process.

Livelihood mapping

A livelihood map was constructed by drawing up all resources in the village. The resources were then divided into three subdivisions; "entirely from village", "partly from village" and "from outside the village". The participants were supposed to choose the option that corresponded to their situation the most. Results from the participants' answers were converted into a percentage for each resource. Ten farmers were participating in this activity. The livelihood map was repeated two times, in order to represent in the situation before the project was initiated (2004) and the present situation (2011).

Case studies

An individual interview combined with drawing of a farm map was performed simultaneously. Three farmers; Tes Tuy, Sok Maly and Im Sarom, participated in this activity. The case studies involved a short interview with each farmer, carried out by the PRA-team. A map of each farm was constructed by the farmer together with an interpreter. Each farmer pictured their own farm before the project was initiated (2004) and at present (2011).

Timeline concerning cattle production

A timeline regarding cattle production was done over the project period. The factors investigated were; animals owned, animals sold, reproduction, diseases, animal feed and water supply for the animals. Ten different farmers participated and were requested to place stones (1-5) on a scheme. The number of stones represented the value of each objective for the individual farmer. Hence, one stone symbolized the lowest value while five stones were classified as the highest score on the scale. Both the situation before the project was initiated (2004), the present situation (2011) and expectations for the future was investigated.

Timeline concerning disease related issues

Another kind of timeline, concerning disease related issues, was also performed. Objectives were vaccination, deworming and disease outbreaks. The time period investigated was between 2004 until present (2011). The exercise included ten farmers and two interpreters and was performed as a group discussion. During the discussion, the interpreters drew the timeline according to what the farmers communicated.

Results

Village resources

The map over Sras Takoun is displayed in appendix 2. Sras Takoun border to Louk village in the east, and is surrounded by rice fields. A primary school and a temple are located close to Sanlong Mountain. There is a road and a canal running along Sras Takoun. Two public ponds are located on each side of the village and one water pump close to the center.

Farm resources found in Sras Takoun are displayed in table 1. The resources was divided into three subdivisions; entirely, partly and from outside the village, depending on the origin of the resources. Both the situation before (2004) and at present (2011) was investigated.

Table 1. Livelihood analyze expressed in percentage over farm resources and their origin; entirely, partly or from outside the village, before the project were initiated (2004) and at present (2011)

Farm resources	Before			Present		
	Entirely from village (%)	Partly from village (%)	From outside (%)	Entirely from village (%)	Partly from village (%)	From outside (%)
Fish – fishing	0	20	80	0	20	80
Fish – raising	0	0	0	0	10	90
Rice	60	40	0	60	40	0
Pork	0	0	100	0	0	100
Beef	0	0	100	0	0	100
Chicken	100	0	0	100	0	0
Egg	0	10	90	0	0	100
Vegetable	10	90	0	10	30	60
Animal feed	100	0	0	40	60	0
Water	100	0	0	0	100	0
Wood	100	0	0	40	60	0
Biodigester ¹	0	0	0	10	0	0
Loan	0	0	0	60	40	0
Natural fertilizer	100	0	0	100	0	0
Chemical fertilizer	0	0	100	0	0	100

¹Only one family had a biodigester

Economy

More than 50 percent of the households participating in the study were considered poor. The definition of being poor set by CelAgrid implied an income below 80 000 riel per household and month. According to the Scandinavian Private Bank (SEB) in February 2013, one riel corresponds to 0.0016 SEK. Except monthly income, information from the village chief and observations on type of house and assets were taken into account. Only 12 percent of the participants were ranked as “better off” where the definition implied an income above 204 000 riel per person and month. The remaining households were classified as “average”. In 2004, CelAgrid made an investigation about current annual income to get a picture of the economic situation of each household. In order to be able to distinguish any progress, a follow-up was made to determine the income for 2010. Table 2 shows the annual income for 2004 and 2010 and the difference between the years. Data for annual income in 2004 was lacking from nine households for different reasons and therefore excluded. All households except one had a positive difference in income between 2004 and 2010.

Table 2. Difference in annual income between 2004 and 2010 in participating households, data from a survey done by CelAgrid in 2010

Village (Farm)	Annual income 2004 (riel)	Annual income 2010 (riel)	Difference annual income between 2004-2010 (riel)	Increase annual income between 2004-2010 (%)
Sras Takoun (1)	2 000 000	3 800 000	1 800 000	90
Sras Takoun (2)	1 800 000	6 000 000	4 200 000	233
Sras Takoun (3)	500 000	3 400 000	2 900 000	580
Sras Takoun (4)	1 500 000	4 400 000	2 900 000	193
Sras Takoun (5)	700 000	10 700 000	10 000 000	1429
Louk (1)	4 100 000	6 700 000	2 600 000	63
Louk (2)	3 300 000	3 200 000	-100 000	-
Louk (3)	2 500 000	3 200 000	700 000	28
Louk (4)	3 600 000	10 600 000	7 000 000	194
Louk (5)	4 300 000	25 500 000	21 300 000	495
Ang Taphouk (1)	3 000 000	7 900 000	4 900 000	163
Ang Taphouk (2)	500 000	2 000 000	1 500 000	300
Ang Taphouk (3)	2 000 000	2 600 000	600 000	30
Ang Taphouk (4)	2 500 000	4 100 000	1 600 000	64
Krang Thnort (1)	3 000 000	21 400 000	18 400 000	613
Krang Thnort (2)	1 800 000	3 400 000	1 600 000	89

Food security

The amount of protein in the human diet had increased in 76 percent of the households since 2004. The majority had access to protein rich food all year round. Only one household answered that the access to protein varied over the year. The most common ways of getting

access to protein was by purchasing pork or beef, slaughtering poultry at the farm or buying fish. The most common type of protein consumed was fish. All of the approached households sold animals to the slaughterhouse at the farm gate, and the majority used a middleman. However, more than 95 percent of the households slaughtered poultry at the farm for home consumption.

Cattle production

Since CelAgrid’s intervention in 2004, the majority (96 %) of the approached households thought that there had been a positive change in number of livestock. All of the participating households kept cattle. Over the year of 2010, an estimated number of 87 cattle were kept and the number of cattle had increased with 26 new animals since 2004. Only one family in Sras Takoun thought that the number of cattle had declined due to sell of animals and lack of labor.

The breeds kept in the villages were crossbreeds and local breeds of cattle. Cows were most common to keep, however, both calves, heifers, bulls and steers were also kept in smaller scale. Generally, the offspring were used as a part of POG or sold. The most common housing system was to keep cattle tied-up inside with shelter. Other common housing systems were tied-up outside with shelter and free-range systems without either fence or shelter. However, housing system could vary with season.

The major problems encountered with cattle production were lack of feed (68 %) and diseases (64 %). Other problems were lack of credit, lack of nutritional feed, fluctuation of the selling price and lack of labor. Results from the timeline concerning cattle production are presented in figure 1. All factors except reproduction and diseases were considered to have had a positive progress until present (2011) compared to before (2004). Expectations for the future were also positive for all investigated factors except for the number of animals owned. The water supply was excluded, since it was unchanged throughout the entire time period. The same pond was used however, the facilities were rebuilt during the project period and two private pumps were added. All households in the village were enabled to purchase water from the private pumps.

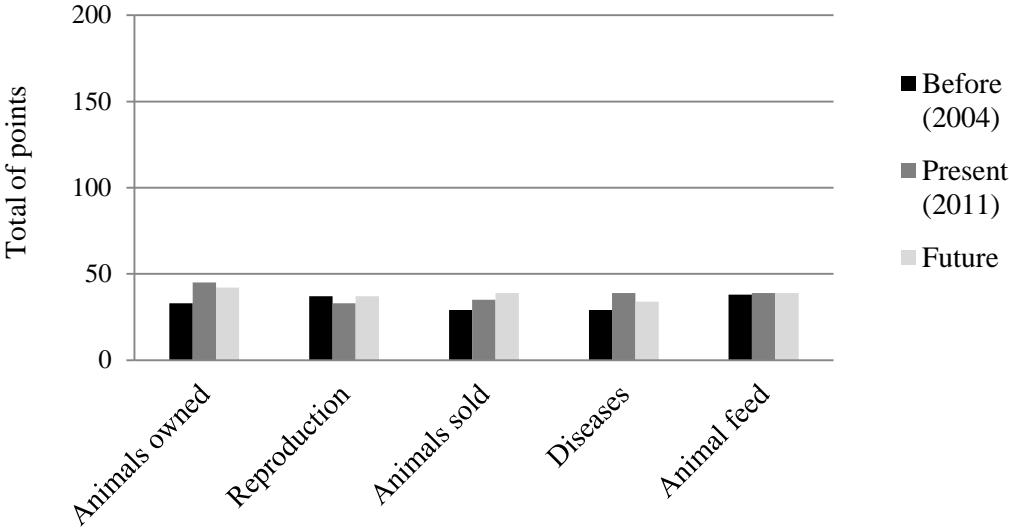


Figure 1. Timeline over factors in cattle production during the project period; differences between before (2004), present (2011) and expectations for the future.

Feed

The dominating crop cultivated was rice, as it was grown by all of the participating households. Other commonly cultivated (>70 %) crops were water spinach and banana tree. Cattle were predominantly fed with grass or rice straw but banana stem or leaves were also used as feed to some extent. According to 88 percent of the approached households, the composition of the feed ratio changed depending on season and 76 percent answered that access of nutritious feed for cattle was reduced during dry season. When lacking suitable and nutritious feed in the dry season, cattle were fed with supplements such as bought grass, banana stem or leaves and rice bran.

Sell of animals

In 2010, the price of livestock sold seemed to be unchanged (48 %) or increased (52 %). A number between 27 to 32 cattle were sold in the year of 2010. The exact number was difficult to perceive due to an uncertainty of when the sell was issued in one household. In this particular case, the estimated range for the sale of the animals was estimated to a period of two to three years.

Diseases

The most frequent occurring disease seemed to be FMD while diarrhea, milk fever and abortion were less common. Veterinarian services were consulted in some cases (36 %) during a disease outbreak. Vaccinations and deworming of cattle were performed between the years 2004 and 2009 (Table 3). Deworming was performed on CelAgrid's initiative. In February 2011, there was a disease outbreak of FMD in Sras Takoun and 15 to 20 cattle were infected.

Table 3. Vaccinations against FMD and Pasteurellosis and deworming performed in Sras Takoun between 2005 and 2009

	FMD	Pasteurellosis	Deworming
2005 (June)	x	x	x
2005 (Dec)			x
2006	x		
2007	x		
2008	x		
2009	x		

Case studies

Tes Tuy

Before the project started in 2004, the household mainly consumed fish as protein rich food and beef or pork only occasionally. In 2011, fish was still the main protein source. The household had access to protein rich food all year round. Before, the main income source arose from paddy rice but after the projects was initiated, selling piglets had become an additional source of income. Thus, the income of the household had been improved. Piglets were born twice a year and sold while the sow was kept for further breeding. POG was

finished, as two piglets had been passed on to another household. A middleman had been used when selling animals to slaughter, resulting in a lower profit however, considered easier for the farmer.

Artificial insemination (AI) had never been practiced on pigs in the household because of the belief that piglets would get weak if using AI. However, the attitude towards new feeding stuff that the projects had introduced was positive. Knowledge about suitable feed rations and nutrients for the animals had been provided and resulted in better growth. Disease outbreaks were considered a failure as well as the attempt of fish raising. There were still no treatments for diseases such as FMD however; a veterinarian had become available in the village. All fish provided by the project died due to different miscalculations, however frog raising was considered as an alternative.

Sok Maly

In 2004 and earlier, the main source for protein in the household was fish. Pork and beef were only consumed occasionally. As a consequence of the projects, the income of the household had increased and enabled an increased amount of protein rich food in the human diet. Before, the income mainly arose from rice production, as the profitability for pig production was low due to disease problems. The projects conducted to a successful pig and cattle production for the household as the animals were properly vaccinated and disease outbreaks could be avoided. For cattle, a vaccine compound provided from the government was used while pig vaccine was purchased at the local market. AI was not used since it was considered easier to use the boar. However, a change of attitude might be possible in the future. In this household, the animals were not sold to a middleman for slaughter. Instead, the pigs were sold to other households as fattening pigs, which resulted in a better profit. The household had not finished POG on cattle.

The attitude towards new feeding stuff for the animals was positive. The projects had implied new knowledge about feeding stuff, nutrients, feeding techniques and general management of the animals. Manure from the animals was used in the biodigester provided from the project. The household had also been provided with fingerlings, but the pond flooded and the fish escaped. Another problem encountered with fish raising was lack of water during dry season and the household terminated fish raising after POG on fingerlings was finished.

In Sarom

The protein intake in the human diet had increased in the household since CelAgrid's intervention in 2004. Fish had always been the main source for protein, and the projects enabled the household to consume fish of their own. Before, a considerable part of the household's income came from paddy rice but a successful pig production had enabled the income to triple. The household had a generally positive attitude towards the innovations that had been introduced in the village by the projects. However, there was stated that the attitude and commitment of the household was of great importance in order to succeed. Pigs were sold as both piglets and fattening pigs. In the future, the aim was that only piglets would be sold since it gains a higher profit. AI had been used on the farm once, and despite failure at that particular time, the household had a positive approach towards using AI in the future. Animals for slaughter were sold through a middleman since it was considered to be the less complicated than selling the animals directly to the slaughterhouse.

Discussion

Poverty is still a widespread problem in Cambodia. Result from the questionnaires reveals that more than 50 percent of the farmers still were encountered as poor in 2011, after the project interventions. This was according to criteria of poverty set by CelAgrid. However, the subjective estimation of assets of the farmers may have been either under- or overestimated. Also, it was difficult for the participants themselves to estimate monthly income, especially since it could vary between seasons. From an economical perspective, a positive outcome was that the possibility of taking loan had increased with 100 percent between 2004 and 2011 (Table 1). Also, the purchase of egg, vegetable, wood and animal feed had increased which could be the result of a higher income. The case studies also indicated an optimistic view on the economic development. All three individuals interviewed argued that their income had increased since CelAgrid's interventions in the village. Also, CelAgrid did an investigation before the projects were initiated (2004) on current annual income of households in four of the targeted villages. A similar investigation was done in 2010 in order to perceive potential progress on income level. The result (Table 2) showed that more than 93 percent of the approached households had a positive development in annual income between the year of 2004 and 2010. The difference in annual income varied between an increase of 28 to 1429 percent. Only one household had a negative difference in annual income during the project period. However, the result in annual income does not fully correspond with the result of more than 50 percent being poor. The stated income in the investigation exceed a monthly income of 80 000 riel in all but three households in 2004. In 2010, none of the approached households would have been classified as poor according to CelAgrid's criteria. A possible explanation might be that the participating households differ between the investigation and the present study. Another reason as previously mentioned can be error of estimation during classification. However, the increase of annual income together with the ability to take loan indicates that the project interventions have resulted in a positive economical change.

Another objective of the implemented projects was to increase food security. Food security has been defined by WFS in 1996 as "*when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life*", thus it includes both availability and accessibility of food (WHO, 2012). Hence, both access and availability of protein on a yearly basis was evaluated in the study. The amount of protein in the human diet had increased in 76 percent of the households between 2004 and 2011. All households but one had access to protein rich food all year round. However, the situation of protein availability before 2004 is uncertain. Two of three farmers participating in the case studies claimed an increase in amount of protein in the human diet since 2004. However, the third had access to protein rich food all year round, which is another positive aspect. The overall result indicates an increase in food security in the majority of the participating households between 2004 and 2011. The farmers sold their animals for slaughter instead of slaughter them at the farm, and the reason for this could be discussed. Instead, meat was consistently purchased with the exception for fish and poultry. Explanations could be lack of knowledge of slaughtering animals or storage difficulties.

In general, 96 percent of the participants estimated that there had been a positive change in number of animals between 2004 and 2011. This might be explained by the contributions from the different projects. CelAgrid applied the concept of POG, meaning that the number of beneficiaries would increase without additional inputs. The impression was positive, however it could be discussed why the farmers could not perceive the exact number of animals

increased during the time period. Especially since cattle are considered as an economic resource in the rural household (Maclean, 1998).

All of the households participating in the study kept cattle and the most common animal category to keep in the villages were cows. CelAgrid provided the participants with cows and cows are beneficial since they are capable of providing offspring. This can purport an additional income as the offspring can be sold. In the villages, offspring were most commonly used for POG or sold. The overall impression by the participants was that cattle production had been improved between 2004 and 2011 (Figure 1). There was also an optimistic view on the future of cattle production. However, reproduction and number of animals deviated. Reproduction was considered to be lower at present than before, but considered to be higher in the future. However, the capability of providing an offspring might depend on the current gender of animals kept. Also, the number of animals kept affects the number of offspring produced. The number of animals kept was considered to decrease in the future. A possible explanation of a decreasing number of animals could be an intended sale in the nearby future.

All of the 25 households cultivated rice and the map of Sras Takoun demonstrate rice fields surrounding the village (Appendix 2). Cattle were predominately fed with rice straw or grass. Rice straw is a by-product from rice production and since all of the households cultivated rice, this was an available feed resource to a low cost. However, the ME and protein content of rice straw is low (McDonald *et al.*, 2011). One way to increase the protein content, is to treat the rice straw with urea. The treatment might double the protein content in rice straw (Saadullah *et al.*, 1981). The most occurring problem encountered with cattle production was lack of feed and diseases. According to 88 percent of the households, the feed ration for the cattle changed with season. Lack of nutritional and suitable feed for cattle was particularly a problem during dry season.

Another concern in cattle production was diseases and in particular FMD, which is a disease caused by a virus. In Cambodia, FMD is constantly present to some degree in cattle production; however it could be prevented by vaccination (Maclean, 1998). Vaccine against FMD is not included in DAPH's vaccination programme (Peda, 2011). However, vaccinations of cattle against FMD were provided by the projects in order to prevent outbreaks of the disease. Vaccinations were done once on a yearly basis between the years 2005 and 2009. In 2010, no vaccinations were performed and an outbreak of FMD was reported in February the following year. One of the case study participants believed that the major failure with the projects was disease problems such as FMD. Cambodian farmers seem to have an incredulous attitude towards vaccination (Peda, 2011). This attitude problem probably arises due to lack of knowledge. Improved and further information of vaccination would be a preferable intervention in the villages.

Conclusions

The interventions by the projects implemented by CelAgrid have been overall successful. It has resulted in increased income as well as increased food security. Both increased food availability and accessibility had been achieved. Animal production and health had also been improved during the project period, but diseases and lack of feed were still a substantial problem. Further education and training of the farmers is needed to change attitudes and improve cattle production. Additional development projects and further research are needed in the rural areas of Cambodia.

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Appendix 1

QUESTIONNAIRE ANIMAL PRODUCTION

Date:			
Village:			
Name of farmer:			
Gender:			
Age:			
Education:			
Family members:	Men:	Women:	Children (0-18 years):

General questions concerning your family:

1. What type of livestock is kept? More than one option can be filled in.

- Pig
 - Cattle
 - Poultry
 - Fish
 - Other:
-

2. Estimate the number of animals (of each kind) over the year of 2010:

Cattle:	<input type="text"/>
Pig:	<input type="text"/>
Poultry:	<input type="text"/>
Fish:	<input type="text"/>
Other:	<input type="text"/>

3. Have there been any changes in the number of livestock since CelAgrid's intervention in your village?

- Increase
- No increase
- Decline

If increase, how many more animals?

And what type of livestock?

If no increase/decline, what type of livestock and what are the reasons?

4. Number of sold livestock in the year of 2010:

Cattle:	<input type="text"/>
Pig:	<input type="text"/>
Poultry:	<input type="text"/>
Fish:	<input type="text"/>
Other:	<input type="text"/>

Price of livestock in the year of 2010:

- Better price than before the project started
- Same as than before the project started
- Lower price than before the project started

5. What type of crops is cultivated? More than one option can be filled in.

- Rice (bran, straw)
- Cassava (leaves)
- Mulberry (leaves)
- Taro (leaves, stem)
- Water spinach
- Banana tree (leaves, stem)
- Other:

6. Sources of income in the year of 2010:

Farm activities	Tick \surd	Monthly income (riel)
Rice		
Vegetable		
Fruit tree		
Cattle/buffalo		
Pigs		
Chickens		
Ducks		
Fish (aquaculture)		
Village shop		
Selling labors		
Government work		
Trading		
Other.....		
.....		
Total		

Income classification: *using available information from village chief, monthly income above and based data collector observation on type of house and asset, tick the category of interviewed farmer:*

- Poor
- Average
- Better-off

7. Responsibilities and decision in farm activities

Farm activities	Men (tick ✓)	Women (tick ✓)
Rice		
Vegetable		
Fruit tree		
Cattle/buffalo		
Pigs		
Chickens		
Ducks		
Fish (aquaculture)		
Village shop		
Selling labors		
Government work		
Trading		
Other.....		

8. Have the amount of meat or fish (protein) in the human diet increased since the beginning of CelAgrid's projects in your village?

- Yes
- No change
- No

9. Do you get access to meat or fish (protein rich food) in the human diet all year round?

- Yes
- No

If yes, how: _____

If no, why: _____

10. Purpose of the animals:

	Cattle	Pig	Poultry	Fish	Other	Other
Meat						
Egg						
Milk						
Skin/Feathers						
Draft						
Plowing						
Other						

11. Do you sell your animals to slaughterhouses at your farm gate?

- Yes
- No

Or, do you slaughter them at the farm?

- Yes
- No

If yes, what type of livestock do you slaughter at the farm?

12. To whom do you sell the animals for slaughter? More than one option can be filled in.

- Slaughterhouse
- Middleman
- Neighbor
- Market
- Other:

13. How much of the produced meat at the farm are consumed by your family?

- Nothing
- Less than half
- Half
- More than half
- Everything

If more than nothing, what type of meat?

14. What type of meat is mostly consumed by your family?

- Pig
- Cattle
- Poultry
- Fish
- Other:

Questions focusing on cattle (in your family)

1. What breed are the cattle?

2. Number of animals at the moment:

Bulls:	<input type="text"/>
Cows:	<input type="text"/>
Heifers:	<input type="text"/>
Calves:	<input type="text"/>

3. If both bull and cow/heifer are kept, do they reproduce and have offspring?

- Yes
- No

If yes, is the offspring:

- Kept
- Sold
- Given to another family (POG)

4. What type of housing system is used? More than one option can be filled in.

- Free – range (without fence or shelter)
 - Free – range (without fence, with shelter)
 - Pen (with fence, without shelter)
 - Pen (with fence, with shelter)
 - Tied- up outside (without shelter)
 - Tied- up inside (with shelter)
 - Other:
-

5. Which feeding stuff dominates the rations for the cattle? More than one option can be filled in.

- Rice straw/bran
 - Cassava leaves
 - Mulberry leaves
 - Taro leaves
 - Water spinach
 - Grass
 - Banana stem/leaves
 - Other:
-

6. Do the fractions of the ration for the cattle change depending on season? (Wet season /dry season)

- Yes
- No

7. Is there lack of usual/suitable feed for the cattle during the dry season?

- Yes
- No

If yes, what do you feed the cattle with instead?

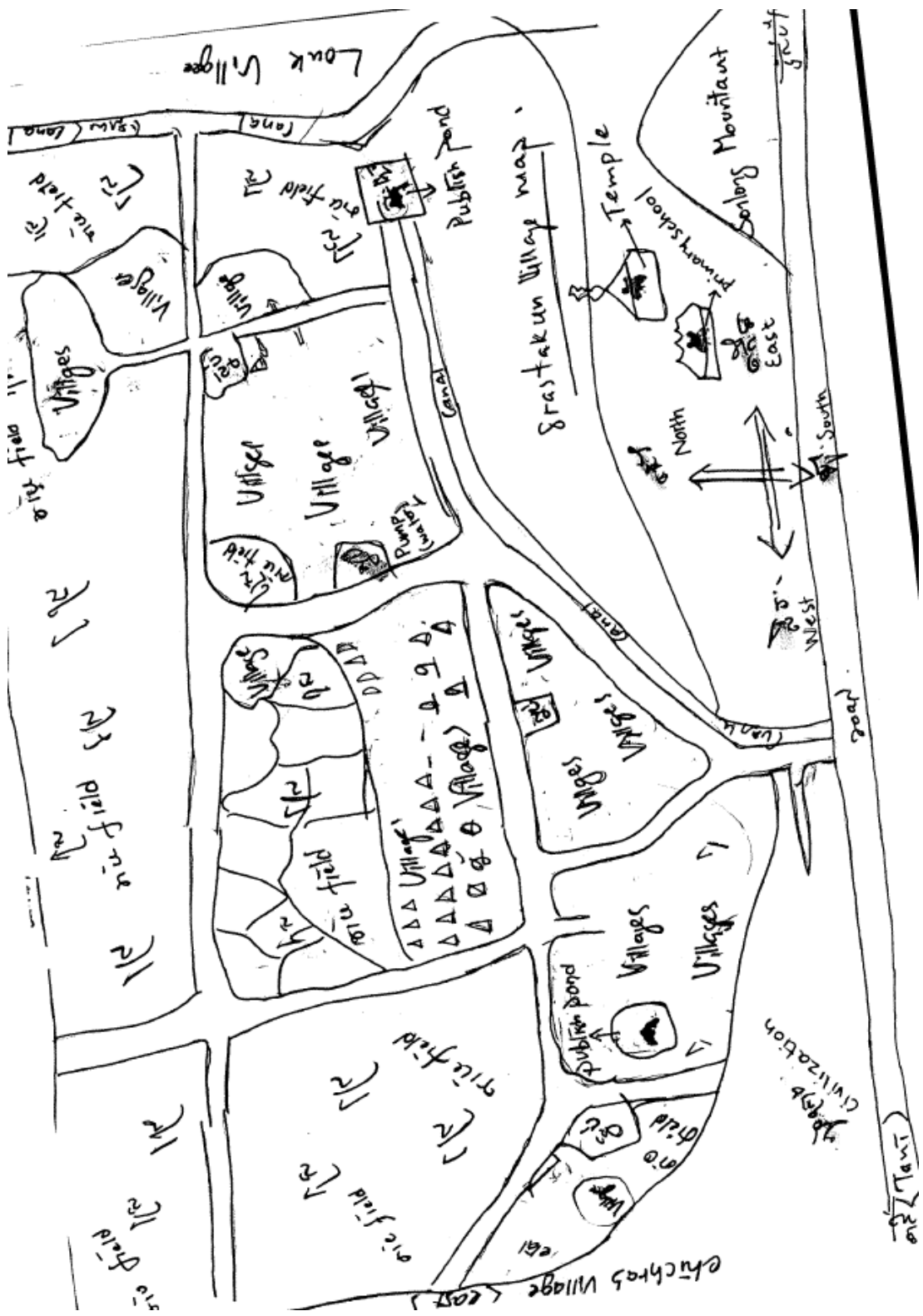
8. What problems do you encounter with your cattle production?

- Diseases
- Lack of feed
- Lack of knowledge
- Lack of water
- Credit
- Breeding
- Selling the animals at the market
- Other:

9. What are the most common diseases in your cattle production?

How do you solve these disease problems?

Appendix 2



I denna serie publiceras examensarbeten (motsvarande 15, 30, 45 eller 60 högskolepoäng) vid Institutionen för husdjurens utfodring och vård, Sveriges lantbruksuniversitet. Institutionens examensarbeten finns publicerade på SLUs hemsida www.slu.se.

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