

Investigating discouraging and encouraging emic reasons to apply eco-efficient farming methods:

- A participatory study with indigenous small-scale farmers in Ratanakiri, Cambodia

Author Lilian-Marleen Beck



Image 1: Own Collection, (2017), Indigenous farmer from Ratanakiri.

Degree Project • 30 credits
Agroecology - Master's Programme
Alnarp 2018

Investigating discouraging and encouraging emic reasons to apply eco-efficient farming methods:

A participatory study with indigenous small-scale farmers in Ratanakiri, Cambodia

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Credits: 30 credits

Project level: A2E

Course title: Master's Thesis in Agricultural Science/Agroecology

Course code: EX0789

Programme: Agroecology – Master's Programme

Place of publication: Alnarp

Year of publication: 2018

Cover picture: Lilian-Marleen Beck

Online publication: <http://stud.epsilon.slu.se>

Keywords: *Agroecology, transdisciplinary research, action research, participative video making, eco-efficiency, cosmology, emic perception, indigenous farmers, small-scale farmer, (non) adoption of innovations, Ratanakiri, Cambodia*

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Abstract*¹

In 2008 the most extensive evaluation of global agriculture in human history notable named “agriculture at a crossroad” was published, indicating that agroecological small-scale farming systems could be a path to follow in the future in order to secure a sustainable food supply. Yet it is claimed that there is a gap between knowledge regarding the methods used for agroecological farming and its application by farmers. Through my literature review I discovered that many studies devoted to this issue have not investigated the underlying interconnected sociocultural explanations. It is critical to investigate the emic (i.e. how local people thinks) perception of farmers in order to understand their decision-making process regarding agroecological methods. This is the root of (driver behind) Farming Systems Research (FSR), which was one key branch within participatory RD&E. Furthermore, when examining the history of agroecological adapted farming systems, one can observe that they have been based on innovations produced by farmers in a continuous set of experiments.

Encountering farmers’ emic perceptions would provide valuable understanding in order to encourage the development of agroecological solutions. This thesis is a case study conducted using action research with the objective to induce an empowerment process in which comprehension is gained in respect of emic perceptions of farmers. The field study is undertaken in Ratanakiri province in Cambodia. Due to a rapid transformative process, the indigenous small-scale farmers in this province have experienced significant changes in recent decades. Land grabbing and pressure, deforestation, and land privatization undermine traditional land management systems. Therefore, shifting cultivation is progressively being replaced by more intensive monoculture cultivation. This leads to decreasing soil fertility, which threatens the agricultural productivity of small-scale farmers. Extension actors involved in agricultural development are teaching small-scale farmers in this area several methods of soil improvement. They now observe that indigenous farmers do not often apply these methods.

In my master’s thesis, I facilitated a collaborative learning process by applying participatory video making in order to investigate the following research question: What are in the emic perspective of indigenous famers the discouraging and encouraging reasons (not) to apply eco-efficient methods? The results suggest that a crucial barrier is the inferiority–superiority dynamic between external teachers and indigenous and the ignorance of the interrelatedness of farming with cosmology. Extension actors ‘meddle on the natives’ turf’ by trying to integrate eco-efficient methods into their cosmologically framed cropping system. As critical components (of the learning process), indigenous people may function as teachers, creating a

credible synthesis of local affiliation, as well as proven and field-tested eco-efficient methods. Therefore, like it is advocated in the field of participatory RS&E, I am suggesting the transformation of the role of extension actors from being a teacher to becoming a facilitator of empowering processes in which farmers are becoming involved in a transdisciplinary, participative systemic and action-oriented research process wherein farmers conduct farm trials.

Keywords: Agroecology, transdisciplinary research, action research, participative video making, eco-efficiency, cosmology, emic perception, indigenous farmers, small-scale farmer, (non) adoption of innovations, Ratanakiri, Cambodia

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Acknowledgements

This Master Thesis was part of the International Center for Tropical Agriculture (CIAT) Asia Forage Group project

“Hands and Minds connected to boost Eco-efficiency on Smallholder Livestock-Crop Systems: Participatory approaches towards eco-efficient livestock-crop systems for smallholder farmers in Laos, Cambodia and Vietnam”

in collaboration with the Royal University of Agriculture, Cambodia (RUA) and funded by the Federal Ministry for Economic Cooperation and Development (BMZ).

I would like to express my greatest gratitude to Dr. Sabine Douxchamps at the CIAT Forage Group Asia for offering me the opportunity to conduct this research and for encouraging, giving me guidance and supporting me throughout the process. Also, I would like to thank with my full heart my supervisor Dr. Anna Hofny-Collins for being my reliable advisor and for her generous support especially in the writing period. Also, I would like to thank Dr. Erik Steen Jensen and Dr. Marco Tasin for their support in the process of the Master thesis project.

This thesis would not have been possible without the passionate commitment of the farmers participating in the collaborative learning process. I feel deep gratitude for having shared this experience with them. My special thanks go to Pest, Poen, Samnang, Bar, Champa, Kham, Fhen and March. I would like to give special thanks to Sathya Phal, Yak, Kosal and Sameon who supported me since my arrival in Cambodia with the research project and their friendship. Without you the collaborative learning process would not have been possible. Also, I would like to give my very special thanks to Rathana for being my partner in crime, for her friendship, her commitment and teaming up with me as the best translator I could ever imagine. Furthermore, I am very grateful for the

support of Dr. Lyda Hok Center Director (RUA, Center of Excellence on Sustainable Agricultural Intensification and Nutrition) and Sreymey Ngoun and Sreymom Sieng from RUA for their support in the fieldwork. Furthermore, I would like to thank Sophearith Sok (CIAT Cambodia) and Manon Königstein for their advices.

I would like to show my highest appreciation to Dr Pamela Richards-Ngwenya for our vibrant inspiring exchange and for welcoming me at DITSL for collaboration. In this regard I would also like to thank Dr. Brigitte Kaufmann (DITSL) and Dr. Margareta Amy Lelea (DITSL) Dr. Kawarazuka, Nozomi (CIP-Vietnam) for inspirational exchange of thoughts.

I would like to thank Emma Tozer and Emily Bari for their great support in proofreading.

I would like to thank Damian for his companionship in the field, being a friend and teaching me how to ride a motorbike.

Last but not least I would like to express my highest gratitude towards my family for supporting me and for being a constant source of light and love in my life.

Lilian Beck, March 2018.

Preface

Learning Experience

As I am passionate about the idea of spreading sustainable agriculture throughout the world, my learning path started with a euphoric feeling towards farms and the study of organic agriculture. However, as everyone knows, with passion comes pain. So, after one year of studying chemistry, animal science and agricultural history, troubling doubts climbed into my head. I began to ask myself what I am going to do with the theoretical knowledge components of my complex area of study. I imagined myself standing in a field telling a farmer about the chemistry table I learnt by heart, going on to realize how useless I would feel, as the farmer is the real expert; they hold knowledge, such as local and hands-on expertise. Hoping to find orientation in the successful development of projects, I repeatedly read about the reason for failure being a lack of knowledge regarding the cultural participation of farmers and the resulting miscommunication. Another book created a turning point in my reflections: Chambers book, *Farmer First*. The idea of becoming like an intermediary between farmers and other cultures to inflict the thinking of politicians and scientists and enable transdisciplinary research meant I was full of euphoria once again. However, when asking how I could shape my encounter and equip myself with the competences needed for this task, I was pushed straight away into a decision crisis. It appeared clear to me that I needed to obtain an approach for gathering sensitive questions of a culture, to understand social dynamics and to gain comprehension of agricultural systems. I could not decide which area to focus upon and a combination seemed challenging: finding an expert who's knowledge is acknowledgement, rather than holistic knowledge. By searching, I developed an understanding of the agroecology program at SLU; through this, I did not only find a possible way to combine social pedagogy, anthropology and agricultural science, but also a discipline that mirrors my own ideas. Yet, making this decision was the start of a learning journey in which I learnt more than I ever expected to. Also, I realized more and more that we are never at the point of having a full understanding of something; there will be a deeper meaning still unveiled left to discover. For sure, the studies of agroecology offered me a deep insight into what interdisciplinarity means. Thanks to numerous intense groupwork tasks and discussions with my student colleagues

from different scientific backgrounds, I realized how much our perceptions and approaches are shaped by the cultures of thinking previously studied. Also, I experienced the challenges and, at the same time, the potential for applying different ways of thinking together. Furthermore, the program offered me the chance to dive into these different cultures of thinking, thus enabling me to conduct my own natural science experiment over three months, as well as taking courses in ecology, plant protection etc. and being introduced into the natural science aspects of agriculture. The program also gave me the chance to reflect on disciplines differences. Yet again, as one can read here, even in my learning process I am approaching new fields as an anthropologist. This recognition made me question my ability to think in an interdisciplinary fashion. I will always think more in terms of an anthropologist and philosopher - even when I am conducting natural science experiments - because it is my chosen approach to understanding the world around me; this is not just because I studied it, but because it is in line with how I think.

We often find ourselves in a typical human dilemma: we cannot get out of our own minds and, therefore, we only understand the other to a certain limit. Consequently, we require a very specific kind of empathy to enable a fruitful exchange in an interdisciplinary agriculture research environment; this means trying to encounter which paradigms and thinking patterns a scientific and personal approach is based upon, without judgment, and acknowledging the potential of different approaches complementing others. As an example, I cannot free myself from being shaped by the culture I am born in, although I can learn other languages and norms to a certain extent and be able to understand others. Moreover, as a stranger to a culture, I can see what is intangible for members of this culture as they take it for granted. Here, systemic thinking which accompanies us throughout the program, comes into play. As previously mentioned, this is one key aspect that raised my interest in agroecology. Yet, while trying to understand what systemic really means and how to act according, I felt that it is a constant act of balancing between the two extremes of going in depth and focusing on details, while losing the big picture or seeing its interdependency on only a superficial level. Also, the program offered me a comprehensive introduction into action research and participative research approaches. In addition, courses in project and conflict management helped me to understand

social dynamics in a different way, giving me ideas of how to mediate and manage an action research project.

Therefore, when given the chance to conduct my own action research project in Cambodia, I felt equipped with a package of knowledge, inspiration and tools. It also felt like learning to swim by jumping into water. I must say that I am very thankful for this learning experience, as it was the deepest and best thus far; it felt like synthesizing and putting all I have learnt from my past studies into action, as well as having the chance to do exactly what I wanted to do throughout my learning path. Nevertheless, there was much to learn and I am sure there always will be. There is not enough space here to outline all that I learnt in Cambodia, but within my reflections about the approach chosen, one can find some thoughts about the important learning steps. I would like to additionally mention two aspects: I realized how important cultural sensibility truly is, and how crucial it is to build up a trustful relationship with participants. The facilitation of the workshops reminded me of working as a social pedagogue or kindergarten teacher, as one must be very present and aware of what is occurring. Moreover, by closing the circle of systemic approaches, I realized how farmers were thinking in systemic terms; this makes it, in my point of view, impossible to conduct transdisciplinary or action research with a non-systemic approach.

While during my previous studies I have felt like a stranger with crazy ideas, in my journey through the Master's program I got to know many inspiring personalities in the field of agroecology who had committed to similar ideas. Moreover, I felt that my ideas were not only confirmed but also challenged by new approaches; this inspired me to ask deeper questions and to also question presumptions. I reached a point where I realized that it would be naïve to believe in paradigms without reflecting upon them in a constant iterative process. I understood how much my comprehension will always be limited, but all we can do is to try. Overall, this work has confirmed in me that I want to devote my life to contributing to the development of sustainable agroecological systems.

Dedication

To the indigenous farmers in Ratanakiri

“Only after the last tree has been cut down / Only after the last river has been poisoned / Only after the last fish has been caught / Then will you find that money cannot be eaten” - Alanis Obomsawin

Contents*

Acknowledgements	4
Preface	6
1. Introduction	15
1.1. Contextualizing the research question – global context	15
1.2. Contextualizing the research question – local context	17
2. Objectives	19
3. State of art: Socio-cultural factors influencing adoption by small-scale farmers of innovations for sustainable agriculture	19
3.1. Biophysical factors	20
3.2. Individual attributes as influencing factors	21
3.3. The role of gender	23
3.4. Socioeconomic factors	24
3.5. External political and socioeconomic constraints	26
3.6. Influence of social capital	26
3.7. Embeddedness of innovation adoption processes in webs of meaning (culture)	27
3.8. Reflection of gaps within the discourse	29
4. Project Framework	31
4.1. Description of the CIAT- Project “Hands and Mind”	31
4.2. The concept “Eco-efficiency”	32
4.3. Theoretical framework	34
4.3.1. Emic perception	34
4.3.2. Systemic thinking	36
5. Material and methods	37
5.1. Description of the local context	37
5.2. Overview of the general research design	50
5.3. Research approach	52
5.3.1. Grounded Theory	52
5.3.2. Action research	53

5.4. Overview of the action-research process in this study	59
5.5. Research periods	65
5.5.1. First period: Explorative period	65
5.5.2. Second Period: Collaborative learning process	75
5.5.3. Third Period: Farmer-led on-farm experiments	105
5.5.4. Fourth Period: Evaluation and discussion of further steps	106
5.6. Practical Remarks for the Implementation	107
5.7. Recording and Data collection	111
5.8. Considerations about the operational analysis procedure	117
5.8.1. Applying principles of Grounded theory	117
5.8.2. Interpretative Phenomenological Analysis	118
5.9. The eco-efficient method investigated	120
5.9.1. EM-fertilizer	120
5.9.2. Natural pesticides/botanical insecticides	120
5.9.3. System of rice intensification (SRI)	121
6. Results	122
6.1. Comments	122
6.1.1. General considerations	122
6.1.2. Guidance for result chapter	124
6.2. Negotiation processes between different cosmological concepts in transformation of culture	126
6.2.1. Traditional concept of being in relationship with spirits	126
6.2.2. Concept of soil fertility in the traditional cosmology	130
6.2.3. Reflection about parallel existing explanation models	133
6.2.4. Concept of pests in Tom Poen cosmology	135
6.2.5. Main ideas motivating a cultural transformation	138
6.2.6. Cultural transformation process through the adoption of different cropping systems	141
6.2.7. Summary: The influence of traditional cosmology on the implementation of eco-efficient methods	143
6.3. socio-economical, ecological and technical feasibility and desirability	148
6.3.1. Emic reflection of the traditional cropping system in socio-economic terms	148
6.3.2. Socio-economical barriers to adoption in the traditional system	153
6.3.3. Emic discourses encouraging reasons	158
6.3.4. Adoption of eco-efficient methods within 'Modern' Cash crop systems	161
6.3.5. Methods are not tackling the problems farmers are concerned with	166

6.4. Reflections about the relationship between teachers and students	167
6.4.1. Distrust in teachers and in new methods	168
6.4.2. Lack of mutual understanding	170
6.4.3. Different learning concepts	171
6.5. Elaborated Grounded Theory for this study	174
7. Discussion	179
7.1. Embedding the results in the discourse surrounding sociocultural influences on adoption	179
7.1.1. Cosmologies are forming the attitude towards adoption of innovations	180
7.1.2. Attitude towards innovation is formed by the quality of teacher– student relationships	182
7.2. Reflection of the method	186
7.3. Transdisciplinary discussion of suggestions	192
7.3.1. Outlined threats which need to be tackled by eco-efficient methods	194
7.3.2. Autotrophics and decomposition sub-system	201
Heterotrophic and decomposition system	211
7.3.3. Management and Allocation sub system	212
Operation	214
7.3.4. Innovation – Possible action research design	218
8. Conclusion	228
9. Critical Reflection	235
Appendix 1. Eco-efficient methods of the action research project	238
EM fertilizer	239
Natural pesticides	241
System of Rice Intensification (SRI)	243
Appendix 2: Benefits of Agroforestry system	245
Preventing erosion	245
Nutrient cycles	247
Competition for nutrients between perennials and annual crops	251
Pest management	252
Principles for IPM in Rice	253
Agroforestry and pest management	255

Appendix 3: Example transcript of recorded interview	257
Appendix 4: Example for field notes of group discussion	261
Appendix 5: Example for transcript of farmer to farmer -workshop	264
Appendix 6: Example of transcript of participatory movie	277
Appendix 7: Example transcript of farmer to farmer teaching	288
List of tables	293
List of figures	294
References*	298

1. Introduction

1.1. Contextualizing the research question – global context

"Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself."
Chief Seattle, 1854

This sentence might seem innocent at first but taking a closer look at the outreach of its meaning, one can interpret a fundamental critic of how so-termed “post-modern” society is conducting agriculture. May I introduce you to a discussion surrounding nothing less important than the following question: How do we secure our daily food? In 2008 the most extensive evaluation of global agriculture in the history of humans was published with the notable title “Agriculture at a Crossroads”. The evaluation investigated the above question and came to the conclusion that there is a need for a shift in agricultural paradigms so as to resolve interrelated global problems of hunger, rural poverty, and unsustainable development. Agroecology was recognized as a promising future path to take in order to secure a sustainable food provision (IAASTD, 2009). In fact, the idea of agroecology is not new, but up until recently it has mostly been receiving attention from institutions aiming to empower small-scale farmers. The report could be considered a turning point in integrating agroecology into a higher political discussion. Remarkably, FAO the prominent institution, in this domain, subsequently organized a symposium on agroecology in 2014 in line with their publications of “Save and Grow” (2011, 2013 and 2016). Acknowledged is the crucial threat to the human population caused by a

“(...) relentless degradation of the ecosystem on which food production depends and the quickening pace of climate change” (FAO, 2016: 7).

Thanks to agriculture based on the intensive use of inputs, productivity has increased remarkably over the last half-century; nevertheless, it has not been able to reduce the number of hungry people significantly and has played its part in the exploitation of natural resources (Production, 2011). Seventy per cent of starving people are small-scale farmers (Howeler, 2013). Thereby small scale, resource poor farmers represent the majority of farmers and produce half of the world 's food. It is therefore questionable that, in fact, hunger is a consequence of a supply-side productivity problem. Rather, it seems to be a problem of empowerment so as to enable maintaining self-sufficiency and purchasing power, i.e. securing access to food. Approvingly, the United Nations claims:

“The world needs a paradigm shift in agricultural development: from a ‘green revolution’ to an ‘ecological intensification’ approach” (UNCTAD, 2013: 1).

A persistent theme in this discussion is a shift in paradigms from systematic approaches focusing on increasing production to systemic approaches taking the multi-functionality of farming systems into account holistically. This is the core of the transdisciplinary, participative and systemic approach of agroecology.

“Agroecology is defined as the application of ecological concepts and principles to the design and management of sustainable agroecosystems” (Gliemann, 1998: 1).

Thus, the aim is to find ways in which to increase productivity through innovative methods which are adapted to local ecological systems by taking them into consideration, making use thereof and, at the same time, preserving and supporting them (Francis et al., 2003). Now it is claimed that there is a gap between knowledge regarding methods aiming towards agroecological farming and application by farmers (Fujisaka, 1994; Pender and Kerr, 1998; Barrett et al., 2002; Shiferaw et al., 2009). Subsequently, in order to boost agriculture based on agroecological methods, it appears crucial to investigate the barriers

to adoption. In fact, a great deal is being written and said about influencing factors on innovation adoption. Through my literature review I discovered that a typical research pattern in the discourse surrounding the adoption of innovations is that of formulating a hypothesis for the correlation between two potential independent variables and testing whether they are statistically correlated to a significant degree. Therefore, many studies have not investigated the underlying interconnected sociocultural explanations. However, I would claim that in order to really understand why farmers decide to adopt or not, we have to investigate farmers' emic perceptions. Furthermore, when examining the history of agroecological adapted farming systems, one can observe that they have been based on innovations produced by farmers in a continuous set of experiments (Hoffmann et al., 2007; Kummer et al., 2016). The underestimated potential of these innovative processes has only recently been taken into account by some researchers, such as Bentley et al. (2010) and Sumberg et al. (2003). In conclusion, investigating innovative adoption processes conducted by farmers in a holistic way and encountering farmers' emic perceptions could provide valuable understanding in order to encourage the development of agroecological solutions.

1.2. Contextualizing the research question – local context

Cambodia lost around 1.59 million hectares of tree cover between 2001 and 2014, and only 3% remains covered in primary rain forestry. The remaining primary rain forestry is mainly found, in fact, in the area in which this investigation took place: Northeast Cambodia. However, in this area we can observe the same phenomena happening: market opportunities and population pressure are changing the landscape of the province of Ratanakiri. Cash crop production is rapidly replacing the once dominant rainforest. After 30 years of war, Ratanakiri is now undergoing agrarian change (Ironsides, 2015). Described in numbers between 2009 and 2014 agricultural land increased by 450% (152,215 ha) (Seidel, 2016)), while forest cover loss 26% (271,045 ha) surface between 2005 and 2015 (ODC, 2017). Driving force of the rapid decreasing in forest is thereby foreign investment into plantations such as rubber or pepper connected with

monetizing logging of trees. Improved infrastructure which allows export and high prices are resulting in attractive business opportunities. The Economical Land Concession (ECL) are legitimizing land grabbing of indigenous communities (Ironsides, 2012; Li and Fox 2012; Naren, 2012; Byerlee, 2014; RFA, 2017; ODC, 2017). Similar to what is happening now in Ratanakiri occurred some years before in other provinces. Khmer farmers who consequently lost their land are migrating to Ratanakiri to find new income opportunities, which in turn is leading to an increase in population pressure. From 2008 to 2013, the per annum population growth rate slowed slightly to 3.99 percent but was still the third highest provincial growth rate in the country (MOP, 2013). This migration set a crucial impulse for land use changes. Predominantly by setting up cashew plantations, Khmer migrants established cash crop oriented mono cropping systems (Ruohomaki, 2003; Hor et al., 2014). Due to this transformation processes indigenous small-scale farmers in this province experienced crucial changes the last years. In fact, those main affected are paradoxically the majority in Ratanakiri, who is often referred to as ethnical minorities (Bourdier, 1995). These indigenous small-scale farmers belong to 8 different ethnic groups which differs in language but are similar in their cosmology.

Just twenty years ago they mainly relied on the forest being mostly hunter and gatherers, had no use of money and were practicing slash and burn agriculture predominantly to cultivate rice and vegetables for home consumption. Recently shifting cultivation is progressively replaced by more intensive cultivation. Yet leaving land fallow has traditionally provided the important natural regeneration processes, accordingly crucial nutrient recycling and in turn preserved soil fertility (Guerin, 2001). Consequently, Tschopp (2017) suggests that nowadays on farms the nutrient cycles are not closed. This most probably leads to decreasing soil fertility, which is threatening the agricultural productivity of small-scale farmers. Those involved in agricultural development are teaching the small-scale farmers in this area several methods for soil improvement. They now observe that indigenous farmers do not often apply these methods. For my master's thesis I facilitated the collaborative learning process by applying participative video making to investigate the research question: ***What are in the emic perspective of indigenous discouraging and encouraging reasons to (not) apply eco-efficient methods?***

2. Objectives

- Developing a grounded theory which seeks to shed light on the emic reasons why indigenous small-scale farmers are deciding not to apply eco-efficient methods in Ratanakiri so as to develop an understanding of the perception of indigenous people.
- Formulating suggestions for local actors and further research into how the implementation of eco-efficient methods can be boosted.
- Boosting the application of eco-efficient methods through induced learning processes in which farmers learn about eco-efficient methods.
- Contribute towards empowering indigenous farmers to become integrated subjects in discourse surrounding eco-efficient methods and how to solve challenges that they are facing by fostering dialogue within communities and with local extension actors.
- Exploring different ways in which to conduct extension activities and induce learning processes in a participative way, subsequently setting inspiring impulses for involved agents.
- Examining participative video making as a tool with which to encourage empowerment and learning processes in respect of eco-efficient methods.
- With the results, contributing to the discourse surrounding barriers to the application of innovations in terms of agroecology.

3. State of art: Socio-cultural factors influencing adoption by small-scale farmers of innovations for sustainable agriculture

The role of this chapter is to investigate the state of art in the scientific discourse about factors influencing the adoption of sustainable agricultural innovations by small-scale farmers. To encounter the main

research approaches chosen and the recognitions gained within this discourse is crucial to understand how this study could contribute to form an understanding of barriers towards application.

Among global and local stakeholders involved in agricultural development there is an interest in developing an understanding of the adoption of processes and which factors influence the implementation of innovations. The underlying, implicit assumption is that a higher adoption rate is needed (e.g. Lockie and Vanclay, 1997; Rae and Gruen, 1997). Several authors claim that the number of successful adoptions by smallholder farmers of innovations such as sustainable land management and water resource management is dissatisfying (Fujisaka, 1994; Pender and Kerr, 1998; Barrett et al., 2002; Shiferaw et al., 2009). Over the years researchers from wide range of disciplines have investigated adoption processes. The main areas of studies conducted were as follows: climate change adaptation, adoption of varieties, and adoption of conservation agriculture (CA and measures for sustainable agriculture in general).

Through this review I discovered that many studies have explored presumed correlations between external or on-farm factors and the adoption of innovations.

In the following the main themes respectively factors found in the review of the discourse are summarized. Those themes are categorized as biophysical factors, Individual attributes of small-scale farmers, the role of gender, socio-economic factors, External political and socioeconomic constraints, influence of social capital and the embeddedness of innovation adoption processes in webs of meaning (culture).

3.1. Biophysical factors

Some studies have aimed to investigate systematically correlations between the adoption of innovations and a variety of biophysical characteristics on farms, such as rainfall. The statistical analysis undertaken resulted in divergent results (Knowler and Bradshaw, 2007, p. 35): Gould et al. (1989), Carlson et al. (1994) and Uri (1997) showed a positive correlation in their studied cases; others such as

Rahm and Huffman (1984) and Clay et al. (1998) did not observe any significant correlation; Fuglie (1999) showed negative results.

Another hypothesis is that soil erosion encourages the adoption of soil-conserving methods. Indeed, some studies could confirm this linkage (Fuglie, 1999; Uri, 1997; Soule et al., 2000; Pautsch et al., 2001). Meanwhile, others do not support this claim (e.g. Clay et al., 1998; de Harrera and Sain, 1999). Knowler and Bradshaw (2007) suggest that examining farmers' awareness of soil erosion as a problem might be more critical to adoption than the problem itself. This implies that the emic perception of farmers might be crucial to shape an understanding of their motivation rather than the scientific evaluation of the ecological situation.

3.2. Individual attributes as influencing factors

First raised by Ryan and Gross (1943), adoption rates seem to differ from farmer to farmer. Thus, it seemed more relevant to understand the characteristics of individual farmers which are encouraging or discouraging adoption (Knowler and Bradshaw, 2007). The key to adoption appeared for some researchers to be more the attitudinal nature of each individual farmer. For example, Gould et al. (1989), Napier and Camboni (1993), and Traore et al. (1998) confirmed a positive correlation between the awareness of problematic soil and the uptake of soil conservation practices. Carlson et al. (1994) outlined that the 'concern for soil erosion' is not found generally in cases of problematic soil conditions. Wickama et al. (2014) suggest that one needs to consider the diversity of local perceptions and priority setting: even if farmers of different communities share a perception regarding land degradation, they do not necessarily consider these factors to be as important as another community in encouraging the adoption of soil conservation methods. Others have confirmed that farmers will only adopt conservation methods if they perceive it to be a major problem (Fujisaka, 1994; Baidu-Forson, 1999; Cramb et al., 1999). Connected to this seems to be the idea that the driving force in adopting methods is the attitude towards them. Others have investigated the attitudes of farmers towards adoption, with some studies (e.g. Warriner and Moul, 1992; Carlson et al., 1994) revealing attitudes as a significant factor, and others not (e.g. Saltiel et al., 1994; Okoye, 1998).

Referring to the discourse surrounding the influence of awareness of problems and attitudes towards innovation methods, one could argue that, besides cultural aspects, psychological aspects are intertwined within the sociocultural context of farmers' decision making. Yamano et al. (2015) devote themselves to this topic in their study of the influence of self-perception on the adoption of a stress-tolerant variety (Swarna-Sub1).

They concluded that NGOs are identifying farmers who have a higher score so as to distribute seeds, or vice versa, i.e. farmers who have higher self-regard are actively seeking to attend extension actor programs (Yamano et al., 2015). They conclude that "(...) empowering farmers, in terms of self-perception, may lead to adoption of new technologies" (Yamano et al., 2015: 3). In addition, other studies point out the importance of self-perception in influencing adoption decisions (Ajzen, 1991; Willock et al., 1999; Burton, 2004; Cramerer and Loewerstein, 2004; Garforth et al., 2004; Rehman et al., 2007; Azman et al., 2013; Datta and Mullainathan, 2013; Martinez-Garcia et al., 2013).

Two other characteristics of individual farmers found to be important influencing factors are the educational level and the age of farmers.

Some found that age has an influence on innovation adoption decisions (Cicek, 2008; Jha et al., 1991; Kassie et al., 2015), as it influences thoughts, behavior and needs. Thus, age seems to be connected to the previous topic discussed: awareness, self-perception and attitudes.

A number of studies found that formally educated farmers are more likely to adopt innovations (e.g. Rahm and Huffman, 1984; Shortle and Miranowski, 1986; Moser and Barrett, 2003; Warriner and Moul, 1992). Others consider educated farmers to be early adopters (Croppenstedt et al., 2003). Cotelear (1990) divides his research findings into formal education, which refers to specific knowledge regarding innovations and informal knowledge composed of attitudes, habits and beliefs. Weir and Knight (2004) suggest that formally educated farmers are more likely to be early adopters. It might also be related to the way in which knowledge is transferred, if it is understandable for farmers not trained in formal ways of gaining knowledge. Moreover, this might explain why some studies cannot confirm education having a high influence on adoption (e.g. Saltiel et al., 1994; Clay et al., 1998) and some even observe discouraging effects (Gould et al., 1989; Okoye, 1998).

Reflecting upon these different dimensions of human decision making for action, Ajzen and Fishbein (1980) suggest that one can find two determining factors with respect to human action: the individual's nature and perceived social pressure. This can be understood as a more holistic perspective in which the individual, in his or her social context, is taken into account. Within this more nuanced discourse, gender is an important consideration.

3.3. The role of gender

Beuchelt and Badstue (2013:2) refer to gender as

“(...) the socially constructed roles, rights, and responsibilities of women and men and the relations between them”.

These roles are defined over time by history, religion, economy, and cultural realities (Doss, 2001). Gender determines power relations and ownership (UNICEF, 2011). Studies of gender have attributed the division of ownership, allocation of resources, and responsibilities within farming systems; for example, in different areas of Africa there is a direct relationship between decision-making processes regarding adoption and gender (Carr, 2008; Doss, 2002; Kiptot and Franzel, 2011; Schroeder, 1993). It is therefore not surprising to find significant differences in the adoption behavior of men and women (Appelton et al., 1991; Quisumbing, 1995).

Several studies indicate that female farmers are less likely to adopt innovations (Ndiritu et al., 2014; Doss, 2001; Ragasa, 2012). Doss and Morris (2001) suggest that this gender difference might be explained by the gender-linked access to resources. Quisumbing (1995) states that female farmers are sometimes less educated, with less land and fewer farming tools. Agricultural modernization took away from many women traditionally ascribed responsibilities. This undermined their power and status, as well as increasing their dependency and workload by diminishing their income (Momsen, 2010; Moser, 1993). Moreover, 40% of the population involved in agricultural production are women, who face restrictions in respect of market access, land, credit and technology (Alarcòn and Bodourogrou, 2011; Kassie et al., 2014; Quisumbing, 1995).

Nevertheless, socioeconomic factors or access to resources may not be the only reasons for gender differences in adoption processes.

Kawarazuka (2017:3) concluded in her study of Thai farmers:

“Women have a cautious attitude to innovation, avoiding risk by choosing small-scale investments, since success or failure in new agricultural practices improves or lowers their gender position in the family and affects their social reputation in the village.”

She therefore points out that adoption decisions are not only economic decisions but also negotiation processes of positions within family households. Social expectations as well as gender positions are involved in this negotiation process and associated changes within these. Consequently, she encourages deep gender-related analysis of locally constructed empowerment processes so as to support women in adoption processes (Kawarazuka, 2017). Therefore, a focus on cultural concepts behind action is necessary.

3.4. Socioeconomic factors

During the course of this extensive literature review the majority of studies were found to focus on socioeconomic aspects. Bjurström and Polk (2011) analyzed the 14,000 references of the (IPCC) Assessment Report in 2001, which looked into climate change adaptation. They concluded that only 12% were conducted in social science, while the majority were economic studies. Casanova-Pérez et al. (2016) found that this is still prevalent in the current IPCC agenda.

The majority of economic studies evaluating influencing factors are household surveys analyzing the correlation between adoption and socioeconomic aspects such as farm scale, land tenure, income, market access, implementation costs, and labor sources (Knowler and Bradshaw, 2007).

Greater access to these goods is supposed to lead to a higher adoption rate. The commonly assessed factor of farm size (or sometimes planted area), nevertheless, turns out to be inconclusive, having compared the results of several studies conducted (Knowler and Bradshaw, 2007). For example, Smit and Smithers (1992) and Fuglie (1999) found that the larger the farm, the greater the willingness to invest in adoption, despite the opposing claims of Shortle and Miranowski (1986) and Clay et al. (1998). Meanwhile, Nowak (1987) and Agbamu (1995) could not claim any linkage. The same variety of results apply with respect to land tenure (Knowler and Bradshaw, 2007). Not all could

support the hypothesis that ownership of land is supportive of adoption while leasing is discouraging (e.g. Nowak, 1987; de Harrera and Sain, 1999). For example, Clay et al. (1998) and Neill and Lee (1999) found that their hypothesis had been proven. Smit and Smithers (1992) and Fuglie (1999) claimed even the opposite to be evident.

Frequently, high income or wealth is hypothesized to favor the adoption of any new technology as an investment which might be needed (Knowler and Bradshaw, 2007). Franzel (1999) explains this correlation by referring to the greater access to information by wealthier farmers and the greater capacity to mobilize resources. He also details how wealthier farmers are less risk-averse and can afford long-term planning (see also Komba and Muchapondwa, 2014).

Besides, this interrelation showed evidence only in some cases. While some found a significant correlation between adoption and income (e.g. Gould et al., 1989; Saliel et al., 1994; Somda et al., 2002), other studies were less conclusive (e.g. Warriner and Moul, 1992; Clay et al., 1998) — Okoye (1998) even refuted it. Thus, we cannot predict this correlation (Knowler and Bradshaw, 2007). Related to this seems to be the income gained through off-farm work. However, the same inconclusiveness can be drawn from reviewing studies conducted on this factor (positively (e.g. Napier and Camboni, 1993; Fuglie, 1999), negatively (e.g. Okoye, 1998; Swinton, 2000) and insignificantly (e.g. Nowak, 1987; Smit and Smithers, 1992).

The explanation offered by Knowler and Bradshaw (2007) leads us to another dimension of understanding. They suggest

“that alternative income sources could provide additional resources for conservation or concomitantly, diminish the priority of agriculture within the household, thereby reducing interest in conservation” (Knowler and Bradshaw, 2007: 10).

By explaining different emerging options connected to farmers' endogenous factors, one can say that they are highlighting the underlying emic reasons as to why farmers use different strategies to deal with economic factors. Indeed, they claim that, due to their review, the majority of adoption studies are relying heavily on econometric analyses of standard farm household survey data. Consequently, the interpretative framework would appear to be weak, as general characteristics of CA (component adopters) are assessed rather than farmers' resource allocation strategies and the social

realities within which they make decisions (Knowler and Bradshaw, 2007).

Summary paragraph: Reviewing these studies did not indicate any factors influencing adoption globally. Andersson and D'Souza (2014) share the opinion that a holistic and empirically grounded system perspective is needed as well as a broader methodological set. They perceived the farm to be in a context of political and socioeconomic factors (Andersson and D'Souza, 2014).

3.5. External political and socioeconomic constraints

Possible external political and socioeconomic constraints (and the failure to link these) include: conservation with livelihoods, extreme poverty and imperfect markets, inadequate property rights systems, and weak organizational and institutional arrangements at different levels (Shiferaw et al., 2009). Thus, improving market access and having access to credit or supportive pro-poor programs could increase the probability of adoption (Shiferaw et al., 2009). Shiferaw et al. often cite examples detailing successful land and water conservation connected to improved market access in Machakos, Kenya (Tiffen et al., 1994; Barbier, 2000). Besides other policies such as subsidies, an input support program was found to encourage farmers in adoption (Anderson and DSouza, 2014). Moreover, commodity price influenced adoption (e.g. Shiferaw and Holden, 2000; Lee, 2005).

3.6. Influence of social capital

Social capital is a concept describing the interconnectedness and interdependencies among individuals in society. Kassie et al. (2013: 405) describe it as

“(...) a combination of variables, such as membership in farmers’ groups or associations, number of relatives in and outside the village that a household can rely on for critical support (Kinship), and number of traders that a respondent knows in and outside the village”.

A deeper understanding of social capital could unveil a more nuanced insight into influencing factors (Knowler and Bradshaw, 2007). Indeed, the notion of social capital as a crucial influence on individual action has increasingly gained attention in related scientific discourse. Relating to this understanding of the social concept examined by previous studies are kinship and ‘connectedness to others’ (e.g. Warriner and Moul, 1992; Carlson et al., 1994), membership in producer organizations (e.g. Smit and Smithers, 1992; Swinton, 2000; Traore et al., 1998), and social networks and personal relationships in respect of technological adoption (Barrett, 2005; Bandiera, 2006; Matuschke, 2008; Isham, 2007; Nyangena, 2011).

Reviewing studies on collaborating actors, three central functions related to the adoption processes are identified: (1) learning and knowledge co-creation, (2) upscaling and institutional entrepreneurship, and (3) out scaling and innovation brokerage (Hermans et al., 2013). Therefore, social capital enables farmers to overcome obstacles to adoption such as scarce or inadequate information sources, imperfect markets, and transaction costs (Pender, 2007; Wollni, 2010; Lee, 2005).

This recognition enhances the need to develop an understanding of these social networks in order to be able to effectively encourage adoption within these structures and, furthermore, support these sociocultural structures. Accordingly, Kawarazuka and Thi Le Thuy (2016: 4) suggest:

“Processes of change in agriculture such as decisions to change crops, uptake of new technologies and knowledge sharing are shaped by historical and cultural practices and values. Exploring social processes of agriculture practices helps develop context specific approaches to facilitate uptake of new technologies in the way that fit well with the social context.”

3.7. Embeddedness of innovation adoption processes in webs of meaning (culture)

Feder et al. (1985) outlined that a typical research pattern in the discourse surrounding innovation adoption is that of formulating a hypothesis for the correlation between two potential independent

variables and testing whether they are statistically correlated in a significant way.

As can be seen, aiming to identify predictable correlations so as to outline globally applicable influencing factors explaining the adoption of innovations has not succeeded thus far. Evidently, as outlined above, many studies have investigated the linkages but not the underlying interconnected social explanations yet looking at underlying explanatory systems and cultural contexts could explain variations in the influencing factors of adoption. The missing-out is possibly due to a reductionist approach in which the embeddings of adoption processes in complex webs of meaning (culture) are not taken into account and innovations are perceived to be technologies. A shift in analyzing adoption processes, in which innovations are perceived to be social processes, can unveil explanations beyond single-dimension correlations: when investigating the way in which farmers perceive and indicate their environment we might understand their decision for adoption or lack thereof. If there is, for example, soil erosion but it is not encouraging the adoption of conservation practices as expected, it might be due to underlying explanatory systems and the perception of farmers.

Leitgeb et al. (2014) investigated the emic concept of successful farmers' underlying attitudes towards adoption methods. They came to the conclusion that different assumptions with regard to reasons for success are determining the willingness towards adoption: the assumption that being a successful farmer means having certain abilities and specific skills which lead to success is related to favoring the application of innovations. In contrast, the assumption that a farmer becomes successful due to exogenous factors such as luck or God is leading to a conservative attitude. Besides, Patidar and Patidar (2015) enhance the significant relationships between age, educational background, farm size, benefits of organic farming, and social factors so as to constitute the perception of organic farming. Therefore, a holistic consideration of these factors seems to be necessary in order to understand how attitudes towards innovations are formulated. Moreover, Beckford (2009) concluded in his study on the uptake of minisett yams three main reasons concerning the way of transferring knowledge. The first hindering reason was the lack of information transferred to farmers in respect of technology. The second reason was a top-down approach chosen by extension actors. Top down is meant

here to be an authoritarian way of teaching. The third hindering reason was an unenthusiastic diffusion strategy leading to a negative attitude towards the investigated uptake of minisett yams. Therefore, the way of transferring knowledge also needs to be taken into consideration as an influencing factor. Kawarazuka and Thi Le Thuy (2016) elaborate on the importance of a specific culture of learning and knowledge-sharing systems among the Dao minority group in Vietnam. They demonstrate that farmers tend to trust the information of their family members rather than of outsiders such as extension actors. Furthermore, farmers needed to observe beneficial effects with their own eyes:

“For example, Hùng, 44, said that his family waited for three years to decide to plant new tree crops in their cassava land as they were still not sure if they do well and therefore they needed to observe other people’s practices” (Kawarazuka and Thi Le Thuy, 2016: 3).

This shows that the quality of relationships and trust generated within teachers and students is crucial. Moreover, a culture-immanent reframing process that gradually transforms the strictly cosmologically governed sphere into one that more and more incorporates active human agency demonstrated being supportive. Foster and Rosenzweig (1995), Munshi (2004) and Singh et al. (2012) came to the conclusion that social learning within social groups is crucial in adoption processes.

This means that ascribed meaning, trustworthiness, and willingness to adopt are also created within the process of knowledge transformation.

3.8. Reflection of gaps within the discourse

Now we have seen that the conceptualization of both “innovation” and “social/farm systems” (agriculture) influences how studies analyze social factors and innovation processes. Note that we can look at innovation as a technical thing or as a social process. If we consider innovation to be a process embedded in a specific sociocultural context, we need to focus on developing sensitive methods, looking at processes of communication, learning, perception and meaning. In support of looking at innovation as a social process it is suggested by

the following outlined reasons to consider innovations for sustainable farming systems as farmer driven innovation processes:

When examining the history of adapted farming systems, one can observe them having been based on innovations produced by farmers in a continuous set of experiments (Hoffmann et al., 2007; Kummer et al., 2016). Experiments conducted in local conditions are crucial to finding solutions for emerging changing conditions (Bentley, 2006; Darnhofer et al., 2010). This local knowledge is of immense value to local adaptation strategies and agricultural innovations. The underestimated potential of these innovation processes has only recently been taken into account by some researchers, such as Bentley et al. (2010) and Sumberg et al. (2003) (Kummer et al., 2016).

For illustration purposes: in Cuba, experiments conducted by farmers played a major role in developing resilient local and national agricultural systems (Leitgeb et al., 2011).

Missing out and/or excluding farmers' local knowledge and cultural context may lead to unforeseen but serious consequences undermining the resilience of small-scale farmers. One example of this derives from Lansing (2009) in his reflection on a traditional water system in Bali called Subak. This surrounds the system of temples as a central social institution around which Balinese society is structured and organized. The watering system incorporates several principles and regulations for pest management, but as the Green Revolution undermined this system and pesticides were introduced, an invasion of a pest called Brown Plant Hopper suddenly became a threat to farmers (Lansing, 2009). This shows the complexity and interdependencies which are crucial to farming systems.

In conclusion, analytical approaches are needed which do seek to integrate farmers' perspectives and gain an in-depth understanding of their way to evaluate innovations. Therefore, an action research approach seems suitable, within which farmers are facilitated in discussing and reflecting upon innovations and enabling the researcher to understand the underlying concepts of action.

4. Project Framework

4.1. Description of the CIAT- Project “Hands and Mind”

The Master thesis is undertaken within the set framework of the project (Hands and Mind) conducted by the International Center for Tropical Agriculture (CIAT) Asia Forage Group as part of the “Improved forage-based livestock feeding systems for smallholder livelihoods in the Cambodia - Lao People’s Democratic Republic - Vietnam Development Triangle” project.

CIAT Asia Forage Group proposed the

“Hands and Minds connected to boost Eco-efficiency in Smallholder Livestock-Crop Systems: Participatory approaches towards eco-efficient livestock-crop systems for smallholder farmers in Laos, Cambodia and Vietnam (Hands and Minds)”

As the projects title already reveals, the aim of this project is to encourage eco-efficient livestock-crop systems for smallholder farmers in the Mengkong region Laos, Cambodia and Vietnam.

The aim is based on the claim, that diversification and integration lead to a more efficient use of resources and besides produce a more varied set of ecosystems services (Lin 2011; Kremen and Miles 2012)

For this reason, it is perceived by the project actors of Hands and Minds as crucial to develop comprehension about current farming systems and adaptation strategies of smallholders in the Mengkong region to react on recent challenges such as climate change and encounter effects on their livelihoods. This needs to be done in order to be able to evaluate cropping systems in terms of their eco-efficiency and resilience. Therefore

“this research aims to work with farmers and other stakeholders to characterize existing livestock-crop systems in terms of their eco-efficiency and resilience” (Bollinger, 2014: 3).

By doing this together with farmers and a range of stakeholders in conducting participatory approaches from the onset the project leader of Hands and Minds,

“(...) hope to concomitantly elucidate and foment practices to improve eco-efficiency of which these stakeholders have full ownership. (Bolliger. 2014: 3)“.

To translate this into action village learning activities, demonstrations and farmer exchanges are facilitated to encourage farmers in the target communities to realize and implement successful ways of boosting eco-efficiency and resilience. Furthermore, the project “Hands and Minds” is aimed at establishing learning alliances among relevant stakeholders to facilitate knowledge exchange and stimulate learning between scientists and non-scientists. One idea is that dissemination materials will be created to be distributed among different audiences for example farmers to policy shapers.

4.2. The concept “Eco-efficiency”

In order to define the characteristics of agricultural methods this investigation is interested in the concept eco-efficiency is chosen in this thesis. “Eco-Efficiency” as a concept was first coined by The World Business Council for Sustainable Development in its 1992 publication, *Changing Course*. Eco-Efficiency defined the term as “creating more goods and services, with ever less use of resources, waste, and pollution.” Inspired by this concept 1992 a United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil, developed an action plan (Agenda 21) for achieving sustainable development and encouraged private industry to implement. Some years later, agricultural experts took up the eco-efficiency banner as well. Integrating it into the discourse about the future path to take for agricultural development, CIAT researchers have joined them,

“stressing that eco-efficient agriculture improves livelihoods by raising productivity and minimizing negative environmental impacts through

more economically and ecologically prudent use of resources“(CIAT, 2011 :15).

In the workshop held to define aims and concepts for the project “Hands and minds connected to boost eco-efficiency of smallholder livestock-crop farms” stakeholders agreed to the following definition of eco-efficiency:

“Increasing the eco-efficiency of an agricultural system means producing more while using fewer natural resources and creating less waste. It is obtained by optimizing the integration between system components. It results from the interaction between environment and agricultural production. As eco-efficiency is context specific, it also contains socio-economic dimension. There are trade-offs between indicators at different scales”(CIAT,2011).

This is the definition applied also in this investigation.

“Eco-efficiency in the simplest of terms is about achieving more with less (Keating et al., 2010: 1)”—meaning gaining more quality and quantity in yield and at the same time reducing negative impacts on the environment by exploitation, or put it differently using “(...) less input of land, water, nutrients, energy, labor, or capital” (Keating et al., 2010: 1). It is therefore a multi-faceted systemic approach, in which it is recognized that farming systems influence and are influenced by both ecological and socio-economic factors (ibid.). In a nutshell, the concept eco-efficiency takes into account interrelationships and trade-offs of different components crucial for agricultural systems (e.g., Groot et al., 2007; Keating et al., 2010). One can say that the simplest idea of eco-efficiency “to achieve more with less” has always driven agricultural evolution, yet recent developments are adding new aspects and the necessity of reformulating and applying such a concept (Keating et al., 2010).

Taken into account the challenge to provide food for a human population of 9 billion or more by 2050 based on water and land resources that are already in short supply, it becomes evident that an approach is needed which protects essential resources by using them efficiently, yet sustainably, whilst at the same time enables the provision of more food.

Eco-efficiency aims further to find local specific ways to deal with assumed trade-offs by applying integrative and interdisciplinary approaches.

Aiming for sustainable agriculture and the systemic approach makes the concept of eco-efficiency an interesting concept to foster agroecological farming systems.

In this thesis I will address more specifically the aspects of soil fertility. This focus seems appropriate as it might be a key obstacle to indigenous farmers in Ratanakiri regarding recent changes in land management systems. Moreover, the loss in soil fertility might lead to threats towards indigenous food security and therefore seems to be a problem in need of addressing. Eco-efficiency includes many other aspects, like for example greenhouse gas emissions and energy efficiency, to mention only two. However, this investigation is undertaken to understand the emic perspective of indigenous farmers. Therefore, I am aiming to frame the investigation within criteria pronounced by farmers to be important. This is why I decided to define the system to investigate in as the farming system, from the point of view of farmers.

4.3. Theoretical framework

4.3.1. Emic perception

In this research, I am not searching for something like a neuter understandable truth or rationalized logic. Instead, I am seeking an emic truth constituted out of presumptions based on cultural paradigms and cosmological concepts. Therefore, I am aiming to overcome the surface of seemingly objective truth by diving into complexity and controversy of culture. The idea of Symbolic interactionism as formulated by the sociologist Blumer is the fundament of this analysis. According to Blumer (1973) individuals act, in reality, they assume. The reality assumption of an individual is in a permanent process of interpretation (ibid.).

Moreover, the phenomenological psychology concept of Schütz suggests that individuals create meaning while interacting with other things and objects by interpreting the interaction and them (Schütz,

2011). In these terms one can also find a relatedness to the following idea of Constructivism:

“Assumptions identified in these works hold that individuals seek understanding of the world in which they live and work. They develop subjective meanings of their experiences - meanings directed towards certain objects or things” (Creswell, 2003: 8).

Therefore, we find ourselves constantly confronted by several emic truths rather than one single neuter truth

“... multiplicity, where rather than a single absolute truth, there are as many truths as there are people; and contextual relativism, where there is an awareness of the importance of contexts in defining truth and value, and epistemologically truth is determined dialectically and interactively” (Bawden and Packham, 1998: 407).

I perceive this process of interpretation as a paradox and a constant investigation and process of negotiation about the meaning of reality through interaction. Thereby, the individuum constantly searches for reassurance that its image of reality is legitimate. However, it is based on the believe that one can perceive a shared reality.

Therefore, in my investigation, I am searching for underlying emic patterns of interpretations and evaluations. Moreover, for inherent negotiation processes. In this manner, my interest is the unspoken meaning which members of cultural groups take for granted. How to unveil cultural concepts which are mainly unarticulated? How to make the implicit explicit? How can we generate a comprehension of the emic logic in argumentation controversies?

Asking simply and directly a question to indigenous farmers in Ratanakiri such as “Why do you not apply eco-efficient methods?” I faced the problematic of expected ascriptions by the informant which might lead into non-articulation of culture-specific argumentations. Therefore, asking as a stranger might lead to a communication barrier as the informant expects non-understanding. In Ratanakiri indigenous are facing discriminating ascription like “laziness,” “stupidity” and “being “childish.” Therefore, expected non-understanding might emerge as a barrier of communciation. At the same time, some emic reasons for might be even hard to articulate because they are not decisive rationalized as they are part of a

complex and controversy negotiation process of cultural paradigms in a cultural transformation. This issue is most likely in an area such as the province Ratanakiri, in which indigenous farmers are recently facing immense changes a long history of discrimination. Guba and Lincoln (1994) pointed out that constructivism stresses the existence of multiple and sometimes conflicting social realities and meanings. In this manner both are perceived as a consequence of social constructions and are in a state of permanent change.

4.3.2. Systemic thinking

This research is framed by a systemic approach influenced by constructivism. To overcome the systematizing way to analyze a farm Bawden and Packham (1998) suggest a systemic approach. Systematic is a way to reduce complexity to aspects which are categorized while systemic is a way to look at the interdependency of aspects and an approach which is aiming for a holistic view (Ison, 2008). The world is understood as an interconnected complex whole (Checkland, 1999). Nevertheless, Systems Thinking (ST) is confronted with a paradox. While it is aiming to understand the investigated phenomenon as a whole in which existing elements are correlated and therefore separation of elements undermining understanding it is not possible to understand without splitting complexity into pieces. Bland and Bell (2007) point out, “If all the world is connected, then there are no connections to make, nothing to transcend, nothing to learn”. I would like to undertake this investigation with the referring to Ison (2008: 174):

“The understanding of a phenomenon within the context of a larger whole, to understand things systemically literally means to put them into a context, to establish the nature of their relationship”.

To be able to generate an understanding and sort the messiness and complexity of the data collected I would like to elaborate themes. In the process of splitting the messiness of a fluid interdependent system into themes, you already realize by observing the resistance interlinkages. Therefore, the process of creating consciously an “artifact” of reality itself is helpful to understand the inextricably intertwined complexity of perceived reality.

To introduce the discussion, I would like to apply the heuristic Hawkesbury model (referred to as the Peanut Model) to decompose the structure developed in order to investigate the decision-making process in a farm system perspective. I would consider this step as being interesting to develop a deeper understanding about suggestions articulated by farmers and discuss them interdisciplinary in a systemic way. Crucial is to encounter the complex web of interconnected components in a farming system. Using this model is a method to have a multi-and interdisciplinary engagement with farming systems which are recognized for their complexity and uncertainty, but still provide critical understanding of the systemic dynamics of a local situation (Ison, 2008).

The Peanut Model will function as the framework for analyzing the farm system, including inputs and outputs, the biophysical sub-systems, the management sub-system, the purpose and the impact different perturbation factors from the external environment (Bawden and Packham, 1993) by integrating analysis of previous research conducted. In a nutshell this model has been a means to raise questions that encourage re-evaluation and further research and helps to extract an understanding of the concept as a whole despite limited sources of information.

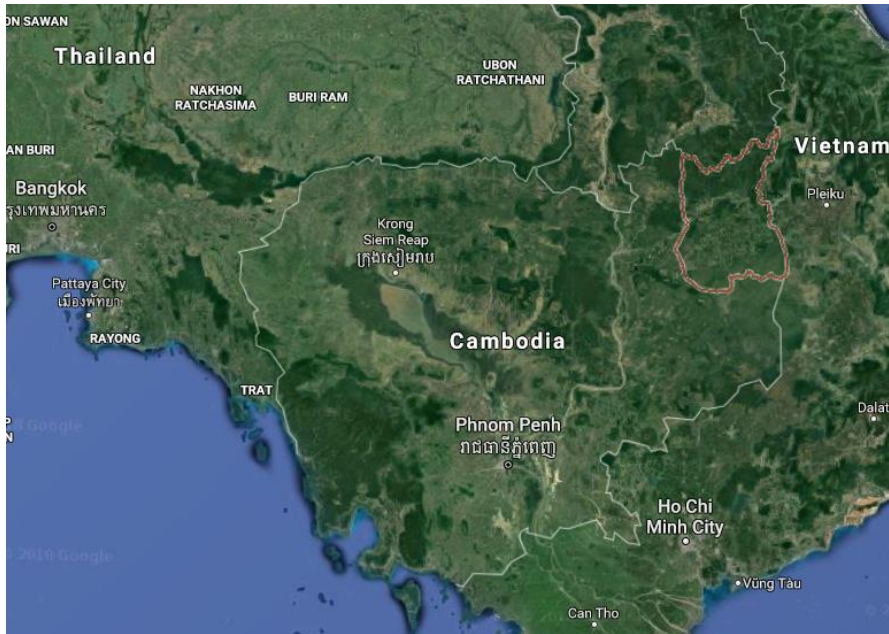
5. Material and methods

In this chapter I will introduce into the local context, outline the research process, the methods chosen and motivate why the research design was set in this specific way.

5.1. Description of the local context

As you can see on Map 1 (google maps, 2018) the northeastern province of Ratanakiri in Cambodia is found at the borders of Vietnam and Lao PDR and can be considered in terms of ethnics most diverse

(Vize and Hornung 2013). Thereby six (some say eight) indigenous are found in this area: Tom Poen which is the largest group (in 2013



estimated to be 56,800 (MOP, 2013)), Jorai, Brao, Kreung, Kraveth and Bunong (MOP, 2013). Beside these indigenous groups other aboriginal groups are home in Cambodia but received little scientific attention and are regarded being in an advanced stage of “Khmerization,”. (Ovesen and Trankell, 2004: 254). In comparison, most indigenous living in Ratanakiri are still living a traditional lifestyle even though new technologies such as motorbikes, mobile phones and televisions are changing their lifestyle (Ironsides, 2015).

Map 1: google maps, (2018), *Location of the province Ratanakiri* [ONLINE]. Available at: <https://goo.gl/maps/rgpLp6Hws252> [Accessed 17 July 2018].

Landright obstacles and giving up on swidden agriculture

The main reason for indigenous people giving up on swidden agriculture are the difficulties they face in holding onto their communal land, which are resulting in adjustment strategies to sustain their livelihood (Ironsides, 2015). In fact, communal land plays a

crucial role yet is not easy to encounter for outsiders. This is for the reason that swidden agriculture is based on a complex land management system in which communal land is a central component. Remarkably farmers were able to maintain the overall forest cover up to 90% thanks to this land management system for several centuries (Fox, 2002; Bourdier, 1995). One could define forests in Ratanakiri therefore as “humanised ecosystems” (Pimbert and Pretty, 1997 in Ironside and Baird, 2003; 60). Many species found in the forests are the remnants of earlier cultivation practices. This long-term forest management highlights a key, yet often overlooked point, that the art of sustainable forest and soil management is minimizing impact and allowing sufficient time for regeneration by rotating over the village area and not farming on one plot for too long (Ironside and Baird, 2003). Indigenous groups in Ratanakiri have demonstrated being able to operate a well-developed land allocation and management system based on an intimate understanding of the local ecosystem (Fox et al. 2008; Ironside and Baird, 2003; Fox, 2002; Bourdier, 1995). As Fox (2002: 116) points out

“In a swidden agriculture system the perceived dichotomy between agriculture and forest is for the most part artificial. Swidden fields, secondary forests, and mature forests are all part of the same agroecosystem”.

Moreover, essential to an ecological and social appropriate land management is an ‘ethic of land use’: “sustainability is a pipe dream without a land ethic as a cornerstone” (Campbell (1994: 254). Thereby the indigenous ‘ethic of land use’ is embedded in a certain cosmology and concepts of territory and ownership. To give an illustration: Indigenous farmers need to achieve an agreement of the spirits, before they can temporarily clear a forest to conduct agriculture with the intention leaving the land fallow afterwards again (Ironside, 1999a). To obtain agreement farmers are conducting for example ceremonies (Ironside, 2015). Frederic Bourdier (2006), notes about the ethnic Tom Poen: “Without certainty of the “agreement” of supernatural powers (through dreams, sacrifices, prayers), no human action can be undertaken” (McCann 2010). Bourdier (2006) suggest describing the concept of being dependent as human being and formulating social structure related to the surrounding nature in contrast to dominating nature with the term “vernacular people”. In reference to this one

realizes a complex cosmological relationship with nature as the foundation of swidden land use in Ratanakiri. The ceremonies are maintaining respect towards spirits. This gives evidence that in order to develop a comprehension of swidden agriculture one fails in considering agriculture as a question of crops, cycles, land rights, social organization, et cetera (etc.) (Ironside, 2011). Considering the forest as belonging to spirits and cannot be owned therefore by humans (Ironside, 1999) can be regarded as opposed to private ownership of cash crop systems. Leaving the land for a rest was based subsequently on cosmological and utilitarian reasons and basis for the development of a rotational system. One illustration of how swidden agriculture refers to ecological knowledge is that rotational system also was extended by even moving whole villages to avoid diseases (Gall, 1998). Through this they addressed the disease called ntrung (a grub which eats the roots of the rice plants) by this rotational system (Ironside, 2012). It becomes evident that

“They have developed over the centuries an intimate relationship with their natural environment by experiencing its potential resources, evaluating appropriate periods of its exploitation, as well as discerning its limits “(Bourdier 1995: 103).

Swiddening can be regarded as a sustainable land management technic relying on in-depth knowledge about different stages of forest regeneration explains (Bourdier, 1995). At the same time, it has been one of the most misunderstood forms of land use among policymakers

“charged with negative prejudices which have contributed to labelling those practicing it as backward destroyers of natural resources and forests” (Erni 2015: 8).

The village area has up to now always been large enough to enable this rotational system (see Cupet, 1891, 1998; Lafont, 1963; Matras-Troubetzkoy, 1983; Baird et al., 1996; Fox, 1998; 2002; Ironside and Baird, 2003; Ironside, 2006; Backstrom, et al., 2006).

Organization of communal land sharing

In respect to the interrelatedness of cosmology with land use it becomes logical that cosmology in fact becomes basis for maintaining communal land management (Irwin et al. 2004). The importance of cultural underpinnings is not only evident in Ratanakiri but observed by a wide range of authors around the world when it comes to swidden agriculture (Cramb et al. 2009; Condonimas, 1977; Conklin, 1975; Boulbet, 1975).

Crucial thereby is the communal land ownership, which allowed the alternation of using land and leaving it for forest regeneration. Besides communal ownership is the basis for resilient livelihood security, for example by enabling to adapt to changing environmental contexts (Ironside, 2012). Concretely communal land ownership is managed under the onset of a customary law by assigning temporally land rights to families to clear and cultivate land in exchange for another land which was given back to the community and then left for regeneration (*ibid.*). This system, being critically different from individual farm management, highlights how significant it is to enable those kinds of property arrangements (*ibid.*). Moreover, the land management system is interrelated with labor exchange arrangements as families with fields in close proximity are helping each other to cultivate the fields (*ibid.*). In fact, traditional agricultural practices rely on cooperation and labor exchange. Notable women's and men's roles are complementary and characterized by a comparable low hierarchical gender and social construction (Matras-Troubetzkoy, 1983; Ironside, 1999; Baird, 2000; Bourdier, 2009).

Land management is based on social and religious institutions

Now negotiation and agreements for land allocations are based on systems of conflict resolutions facilitated by leaders who are tasked with mediating the earthly and the spiritual level (Ironside, 2012). So, called elders are in charge to facilitate conflict management in order to make people united (Backstrom, et al., 2006). In addition, ceremonies have an important function for maintaining community solidarity as they are social happenings involving helping each other and sharing meals (Ironside, 2013).

Ceremonies become an institution for maintaining and reproducing samaki (an emic term for cooperation and solidarity) by being the precondition for organizing village ceremonies and in turn strengthened by these activities. Beside it is representing an avenue where farmers can negotiate and discuss land allocation. Likewise, samaki is the basis for resolving problems in the village, and the basis for labor exchange, as well as for sharing the village's communal lands (Ironside, 2013).

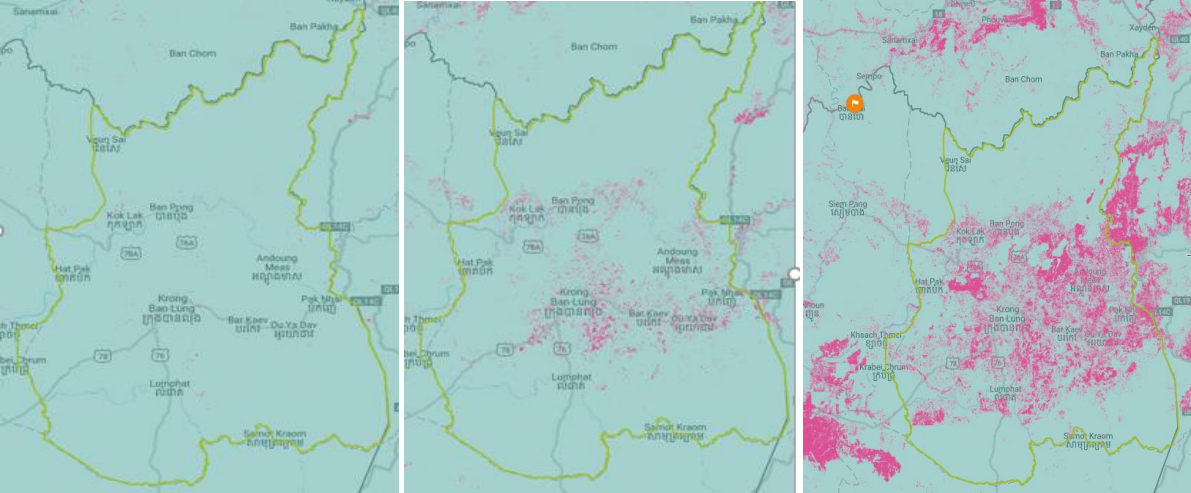
Undermining of communal land due to dispossession

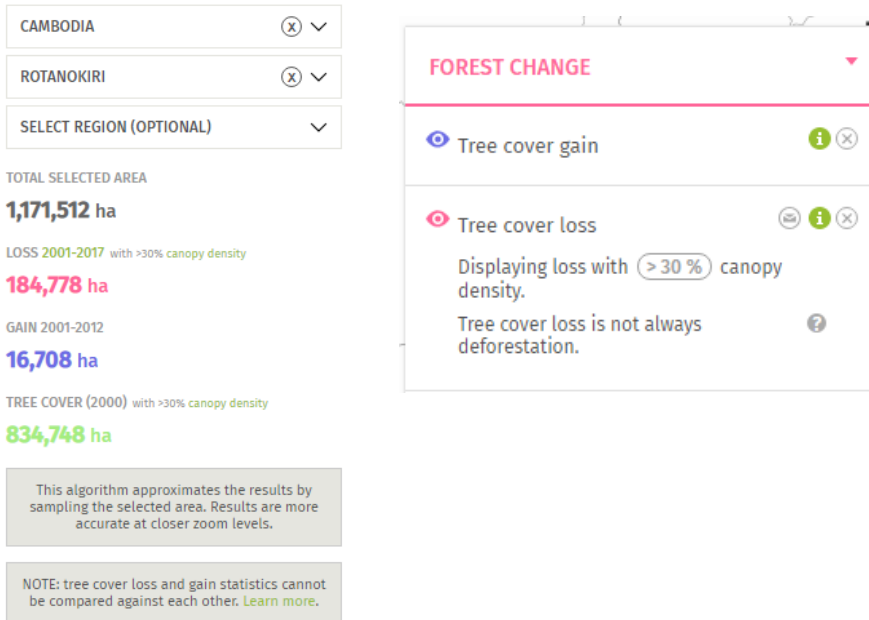
Cambodia is known being a “hot spot” for land grabbing in Southeast Asia as farmers are experiencing uncountable cases of dispossession, forced evictions, and escalating conflicts and protests. These cases are emerging mainly due to illegal logging and economic land concessions (ELCs), which permit the use of renting state land for 99 years under the 2001 Land Law (Park 2017). Ratanakiri is no exception to this and while only few rubber plantations were established in the colonial period (Matras-Troubetzkoy, 1983), since 1993 when Cambodia opened up for international investments and new road networks an immense pressure on land emerged (Fox, 2009). In fact, in 2014 eighty percent of land concessions in the whole of Cambodia were assigned for establishing rubber plantations (Global Witness, 2014) thereby approximate 770,000 people have been affected by land grabbing (Ironside, 2015). Tragic is also the reported respect less treatment of the indigenous people. They experienced abuse of their rights, the destruction of spirit and burial forests, the intimidation, coercion and misinformation which has accompanied land grabbing (Milne et al. 2015; Global Witness, 2013, 2009; Subedi, 2012; OHCHRC, 2007, 2004; Ironside and Nuy, 2010).

Pressure to develop adoption strategies

The maintenance of traditional land management system is threatened by competition for land which is becoming a scarce resource due to logging, land concessions, immigration and a general population

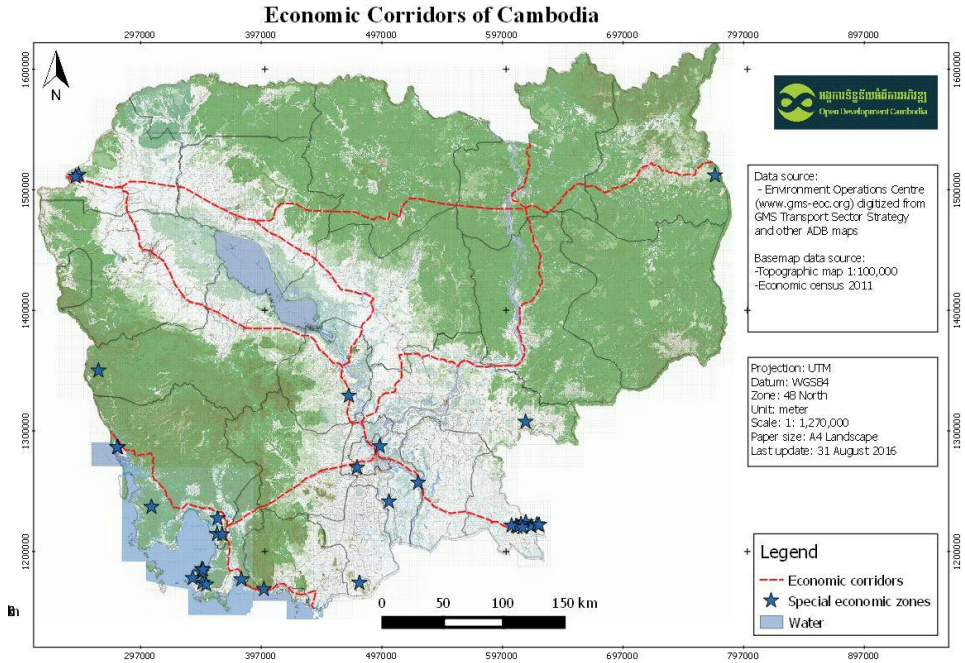
growth (Fox, 2009). On map2 you can see the immense tree cover loss between 2000 and 2017.





Map 2: global watch, (2018), Forest loss in Ratanakiri 2001, 2007 and 2017 [ONLINE]. Available at: <http://bit.ly/2BOCZsN> [Accessed 30 April 2018].

These stress factors are partly result of the government promoting Ratanakiri as forth pillar for national economic development and the economical corridor established to link Bangkok with Vietnam and China that goes through Ratanakiri (Ironsides, 2015).



Map 3: Environment Operations Centre, (2018), Economical Corridors Cambodia [ONLINE]. Available at: <https://opendevelopmentmekong.net/dataset/?id=economic-corridors-of-cambodia> [Accessed 28 April 2018].

Furthermore, under these external influences’ incentives are created towards viewing land as a marketable commodity (Fox, 2009). To illustrate this shift: Farmers have increasingly decided due to land alienation, privatization and land insecurity, to grow cashew on land which was traditionally left for fallow (Shiva, 1993). This is a strategy to protect the land from being regarded as ‘ownerless’ by external actors (*ibid.*). While families thereby secured land to be taken away by ‘externals’, land available for shift and burn practices are becoming even scarcer. Subsequently the adaptation strategy to land pressure is a rotating system of different crops or mono cropping of cashew. Due to the non-application of fertilizer and the missing regeneration periods this leads probably to the mentioned degrading of soil quality. Likewise, the perennial cashew has resulted in a more individualized land use as conducting alternating land possessions is not feasible with perennials (Ironside, 2015). Since indigenous people were originally hunter and gatherers in the dry seasons, non-timber forest products

(NTFPs) such as food and materials for everyday life were important to sustain their livelihood (Matras-Troubetzkoy, 1983; Baird, 2000). However, due to increasingly disappearing forest areas in recent times, farmers lose this food source and need to provide food by buying it from the market instead (McCann, 2010). Besides cultivating cash crops, one strategy for income is to poach rare animals and sell them to Vietnam and China. Examples are the pangolin with its reputed traditional aphrodisiac properties, or the macaque -two species that are now extremely rare in Ratanakiri (*ibid.*). This illustrates how an ethnic group, which was able to preserve ecological diversity over centuries, adopts under pressure strategies destructive towards their natural environment.

New desires and opportunities

As Harold Brookfield (1972; 1984) once recognized, changes are often not solely driven by pressure, also recognizing new chances for changing livelihood might foster new strategies (Fox, 2009). How McCann (2010: 16) puts it:

“Perhaps it is an axiom that migrations to the region, particularly in an age of globalization, are irreversible and futile to resist”.

To mention some gain which indigenous might receive from migrants into their area is education and healthcare (McCann, 2010).

Undermining of communal land

Indigenous people’s experience that customary rights over land are not respected by investors or government, and the fact that they are being told that they will lose their land anyway (Ironside, 2012) have caused indigenous people to sell their land and communal land (*ibid.*). Nevertheless, many recognized the danger in this behavior as they understand that selling the land gives only money once, but after they are left without income source (*ibid.*). This is only one example for how the undermining of communal land is leading into a breakdown of solidarity and resilience. As described above, swidden agriculture is interwoven with the social structure and important institutions such

as conflict management and labor sharing providing resilience. For this reason, the undermining of communal land which results in giving up shift and burn cultivation is leading to the breakdown of interrelated social structures. Subsequently the livelihood, lifestyle and identity of indigenous communities in Ratanakiri is under threat, increasing landlessness and food insecurity by undermining social resilience (Ironside, 2015). Also, observable are repercussions on systems of beliefs (Park, 2017). Social cohesion and a real sense for fostering long-term solidarity is overshadowed by developing short term surviving strategies in insecurity towards individualization (Bourdier, 2009). Bourdier (2009) claims that marginalization is created through a political hegemony promising national welfare (*ibid.*).

Land law for communal land titling

In 2001 Cambodia released a land law which remarkably acknowledge the right of indigenous people to communal lands and providing a favorable environment for enforcing communal land titling. This was the first time to acknowledge certain rights to indigenous by issuing the term ‘Indigenous Peoples’ or *chuncheat daoem pheak tech* in Khmer as a legal category (Baird, 2013). Despite while assigning communal land titles is in reality scare, land grabbing is much more rapid (Subedi, 2012; OHCHR 2007; Danida, 2010; Ironside and Nuy, 2010; Ironside, 2011; Neef et al., 2013) although the law was released to protect against it (Bugalski, 2012). Therefore, one can say it had symbolical significance in acknowledging indigenous identity (Baird, 2013), then actually providing better conditions for indigenous on an practical level.

Long history of discrimination towards indigenous

This is only one chapter in a long history of discrimination the indigenous in Ratanakiri have experienced: Throughout the history indigenous were confronted with ascriptions by outsiders of being inferior, inhabiting wild jungles, nomadic and without culture. Contrastingly to their efforts and accomplishment to maintain their independence through history, indigenous were seen as either slaves, serfs, cannon fodder, or at best children (Ironside and Baird, 2003). Subsequently indigenous were confronted with radical plans of deculturation, ‘modernization’, substitution of traditional languages

by Khmer and the conversion to Buddhism (Baird, 2008; Meyer, 1979). Brutal repression by the Sihanouk government led to resistance, fleeing in the forest and open revolts organized in the form of guerrilla warfare. Plans of the government to conquer the area and develop it as an economic center by establishing rubber had to be stopped under these conditions (Meyer, 1979). The Khmer Rouge settled in the 1960s in Ratanakiri and became initial allies against Sihanouk forces (Colm, 1996). Until 1973, indigenous were left free to practice their traditions, but when cooperatives began to be created restrictions were imposed (Colm, 1996; Baird, 2008). Resulting resistance on the side of indigenous was answered by the Khmer Rouge establishing prisons and killing fields (Colm, 1996). Partially production was collectivized and, in many cases, swidden agriculture was forbidden (Baird, 2008; Colm, 1996). Many suffered from extrajudicial killing, mass displacement, banning of religious beliefs and rites, forced labor and dismissal of traditional agricultural practices (Biernan, 1996). This led to masses of indigenous fleeing to Vietnam and Laos (Baird, 2008; Colm, 1996). After the fall of Khmer Rouge the indigenous people experienced relative isolation from 'modern state making projects' (Scott, 2009).

Conclusion for this investigation

In view of this cruel history it is illustrated ironic and disrespectful towards the indigenous people when executors of land right assignments tell them: "If you want to keep using your land in this way, you want our country to go back to Pol Pot times" (Rabe, 2013: 22). This is a rhetoric aligned with the comparison of the claim for traditional communal lands to the collective agriculture practiced by the Khmer Rouge. One can find similar presentations of indigenous as 'model communist' by Khmer Rouge. Nevertheless, it reflects ignorance and a failed encounter of the communal land management system which differs significantly from collective agriculture (Ironsides, 2015). Moreover, the dispossession and the transforming of subsistence swidden farmers into producers for the market economy is embedded in a discourse of bringing 'civilization' to the 'backward' ethnic minority groups. In similar lines neighboring indigenous groups from the Central Highlands of Viet Nam have been settled justified by a discourse about environmental 'destructiveness' of indigenous

communities' practicing shifting burn cultivation (Cramb et al. 2009; Salemink, 2003).

With regard to this history and recent events on which this literature review shed some light, it becomes evident that land pressure and the transformation of swidden agriculture towards market-oriented cash cropping is not solely result of land pressure resulting in ecological obstacles. Much more it is involved in a deeply rooted discourse of power conflicts and discrimination. Far more regarding these issues as solely ecological concerns would leave out the interrelated dimension of social and cosmological embeddedness of swidden agriculture and the transformation of culture happening due to adoption of new agricultural technologies.

This sheds light on the dimension of the research question posed for this investigation and the need to carefully develop an encounter how these dimensions of cosmology, social structures, power discourses etc. are involved. These diverse dimensions demonstrated to be involved in a process of transformation. Furthermore, it gives ideas how asking the research question might touch sensitive topics in relation to those dimensions. It becomes evident that methods and approaches for this investigation have to be chosen carefully to sensitively avoid reproducing power structures and ascriptions of backwardness and childishness. The aim should be to empower indigenous then to feel fully respected in their rich ecological knowledge and encourage talking about dimension possibly hidden because of having experienced to be punished for it.

Relating to the state of affairs elaborated in this literature reviews the research question constitute a complimentary to the focus taken by many studies on land right issues. As this thesis is concerned about understanding the emic perception on suggested innovations to improve their farming systems it is aiming to understand discourses of adaptation strategies, collaboration between extension actors and indigenous and to shed light on underlying emic concepts.

5.2. Overview of the general research design

This research project is an action research project conducted within the framework of Grounded Theory put forth by Strauss and Corbin (1996). Structurally speaking, the study was organized as a series of path-dependent steps that allowed for a progressive immersion in the physical and social contexts of the study area. Moreover, this organization allowed for a participative process facilitation, integrating the considerations of the participants (indigenous small-scale farmers).

As one can see in Figure 1, the process can be divided into four different periods:

- The first period focused on exploring the research field by using PRA tools in group discussions and semi-structured interviews and organizing multi-stakeholder workshops.
- The second period entailed the facilitation of a collaborative learning process in which farmer-to-farmer learning processes took place and reflection processes about the application of eco-efficient methods were induced.
- The third period consisted of farmer-led on-farm experiments during which participants from the collaborative learning process experimented with eco-efficient methods of which they had gained knowledge while the process was ongoing.
- In the fourth period, farmers reflected on the results of their experiments and discussed potential next steps for a continuing collaborative learning process.

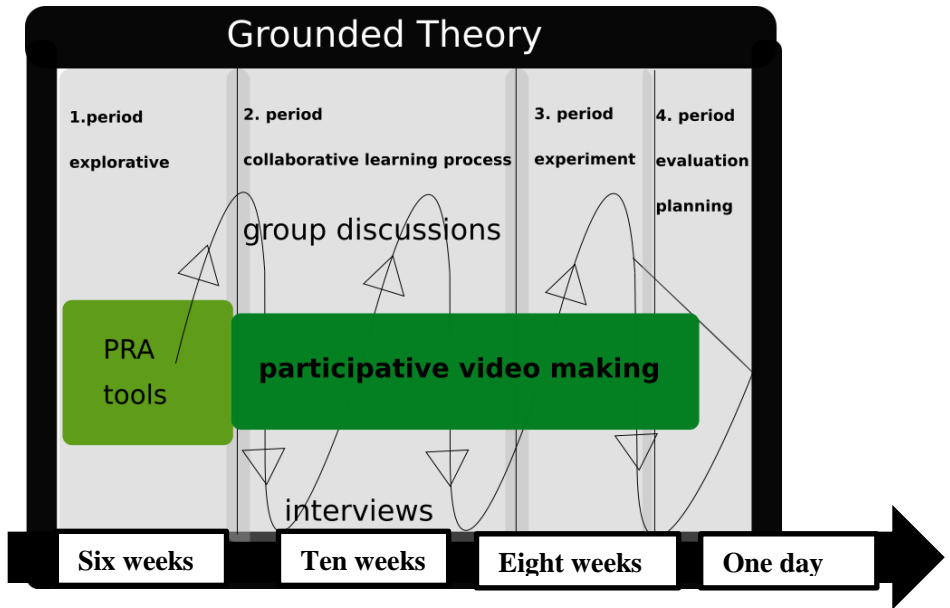


Figure 1: Own Collection, (2017), Research design.

The whole research project was organized according to an iterative study design, borrowing the principles of Grounded Theory. An iterative study design entails that data collection and analysis take place simultaneously, while the analysis informs the next cycle of data collection. Furthermore, as one can see in Fig 1, a mix of different methods was applied in a complementing way, which is described in detail in the following chapters.

Thereby this study was conducted over a period of in total six months. As Figure 1 shows the exploration period was for six weeks. Based on these explorations the collaborative learning process was facilitated for ten weeks. Applying the knowledge gained the experimental farmer-led-farmer trials were conducted within a period of eight weeks in the rainy season. And the evaluation of the collaborative learning process as well as of the results of the field trials was conducted in a one-day workshop.

5.3. Research approach

In this chapter the main research approaches chosen for this study and their principles and concepts will be elaborated and explained. Furthermore, it will be explained why these methods have been chosen for this study.

5.3.1. *Grounded Theory*

While searching for a theoretical framework for my research approach, which is based on the same social scientific assumption on which this investigation is based, I decided to choose Grounded Theory by Strauss and Corbin (1996). This approach of framing a research project shares the assumption of Symbolic Interactionism by Blumer (1973) and offers the possibility to analyze elements in their interdependency related to a systemic approach (Charmaz: 2006).

'Grounded Theory' can support scientists in generating theories based on the data collected which provides possible explanations for questions of the empiric. The aim is to enable actors to react towards empiric problems but also to contribute to scientific discourses (Strauss and Corbin, 1996). This aim is in accordance with the aim of this investigation.

To guarantee a denser empirical reference and avoid presumptions, I decided against following the often-chosen way of approaching the field by developing hypothesis which are compared then to the data collected in order to confirm or to not confirm them. As suggested by Strauss and Corbin (1996) my approach was to rather generate a grounded theory out of the collected data.

Nevertheless, according to Grounded Theory this investigation is not purely inductive but will be undertaken with support by considered useful heuristic concepts.

“Culture has a significant effect in deciding a person’s preference for abstract conceptualization versus concrete experience. The significance of its effect on the preference between active experimentation and reflective observation is marginal” (Joy et al., 2009: 16).

Moreover, I will take into consideration the Constructing Grounded Theory formulated by Charmaz. Charmaz suggests reflecting to a

possible degree the subjectivity of the researcher and the inseparability of perception and experience as well as incorporated concepts from interpretations. Therefore, theoretical concept and references which are influencing the perception of the scientists have to be declared transparently (Charmaz: 2006).

The reflection on the approach and the methodology serves the critical self-reflection, transparency and engagement with researcher's subjectivity. To reflect this and avoid the implication of objectivity I will formulate this thesis in the first person "I".

5.3.2. Action research

When researching for a method that integrates farmers' perspectives and gains an in-depth understanding of their methods of evaluating innovations, the action research approach appeared the most suitable. This research approach, which is presently facilitating a socio-cultural reflection process among farmers, enables researchers to develop an understanding of the negotiation processes within different farming system components and the influencing factors, as well as different standpoints. Action research is constantly progressing (Brydon-Miller, 2016) and is advocated in the fields of education, social work, international development, healthcare etc. with increasing interest; that is, the 'helping' professions (Bradbury-Huang, 2010). The definition of action research provided by Peter Reason and Hilary Bradbury (2001: 1) is utilized for this study:

“Action research is a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities”.

This paper will investigate this multifaceted understanding of action research, fundamental to which is the idea that social reality is a continuing process: individuals are subjects of their history and the social contexts they are dependent upon. This complexity of social reality can only be understood by trying to alter it, meaning by getting involved with this complexity and the encompassing subjects

(Brydon-Miller, 2016). David Coghlan claims a basic tenet of action research as being:

“the powerful notion that human systems could only be understood and changed if one involved the members of the system in the inquiry process itself” (cited in Brydon-Miller, 2016: 5).

Subsequently, a key value shared by action researchers is them paying abiding respect for the targeted persons’ knowledge and for their capacity to reflect upon, develop an encounter and find solutions for the issues confronting them and their communities (Brydon-Miller, 2016). In this manner, action researchers do not strictly separate understanding and action. Rather, the idea is that only through action can a legitimate encounter be possible: “theory without practice is not theory but speculation” (Bradbury-Huang, 2010: 93). Here, the symbiotic ‘twofoldness’ of action and research comes into play: on the one hand it means being active in terms of working towards practical outcomes, while on the other it is creating new forms of understanding, since

“action without reflection and understanding is blind, just as theory without action is meaningless” (Reason, 2001: 2).

Therefore, the purpose of action research has a very practical orientation. According to Reason, a primary function is to create knowledge that enables people to improve the everyday conduct of their lives, as well as to contribute to the increased well-being (i.e., economic, political, psychological and spiritual aspects) of humans and communities. This comfort equals a more equitable and sustainable relationship with the wider ecology of the planet. Kemmis and McTaggart (2005) reflects upon this commitment to action which brings about change as the crucial difference of other inquiries in the act of research (Brydon-Miller 2016). McNiff (2016) suggests that this change needs to begin with an induced learning process.

According to Kemmis and McTaggart (2005), PAR should be regarded as a social, participatory, emancipatory, critical, reflexive and transformative process; it implies a learning process through “diagnosis, analysis, action and evaluation” (Chesler, 1991: 760). In these iterative and non-sequential processes, participants are learning from shared experience and are generating knowledge as a mutual enquiry between the researchers and participants (McTaggart, 1994).

This process can be described as evolutionary: it emerges while skills of inquiry within communities are developing (Reason, 2001). Ernie Stringer reflects upon the position of the action researcher as being that of a facilitator. The action researcher should empower the participants to conduct themselves in a manner that will fit their own cultural context and lifestyles. The participants – not the outsiders – should be the ones to determine the nature and operation of the events that will affect their lives (Brydon-Miller, 2016).

How can we, as action researchers, facilitate a knowledge-generating process aiming for improvement of the wellbeing of participants, communities and for boosting democratic social change? Profound is the rejection of a positivistic view of knowledge: it holds that to be credible, research must remain objective and value-free. Instead, action research is based on a view of knowledge being socially constructed. Subsequently, all research is embedded within a system of values; it promotes a model of human interaction (Brydon-Miller, 2016). According to Webber and Ison (1995), scientific knowledge is commonly regarded as being superior since it is backed by data and empirical methods. Traditional and local forms of knowledge cannot be codified by mainstream scientific methods and, thus, they foreclose the ability of the non-scientific audience to contribute to the development of a body of knowledge.

Therefore, as Pretty (1995) advocates, there is a need for a transformation in the way social research is conducted; it needs to move towards a more inclusive and adaptive way of doing research. This change requires some sort of participatory approaches. Similarly, Chambers (1994) argues that a change of paradigm entails a transition towards a departure from etic to emic narratives. So, which methodological approach is chosen to conduct action research?

According to McTaggart (1994), PAR cannot be regarded as a method or a procedure; rather, it is an orientation to research comprised of a wide range of methods (Khanlou and Peter, 2005). In fact, the practices of action research have evolved in a mixture of anthropological methods, field research on farming systems, agroecosystem analysis and Participative Rural Appraisal (PRA) (Chambers, 1994; Cornwall and Pratt, 2011). As it is an integral part of action research, PRA should be looked at in more detail.

Chambers (1994) defines PRA as a set of different approaches and methods that enable learning about rural life conditions and promote the empowerment of local communities. PRA means learning “by, from and with” rural people (Chambers, 1994) as a catalyst of problem identification and the solution-finding process (Webber and Ison, 1995) owned by the participants. The approach to fulfil this purpose is the facilitation of a process in which reflexive, analytical and communicative capabilities are encouraged (Chambers, 1994). By ‘handing the stick’ to the participants, PRA is opening the avenue for an alteration in the commonly-given power relations between researchers. PRA seeks that communities identify and become owners of their own problems, which eventually leads to the solving process (*ibid.*). Beside the ownership of knowledge ownership, the long-lasting effects on the critical enquiry capacity of subjects, as well as a consensus between participants and inclusiveness, are crucial within the PRA approach (Chataway, 1997; Kemmis and McTaggart, 2005).

PRA attempts to balance out scientific epistemologies and traditional, as well as local sources of knowledge (Webber and Ison, 1995). In fact, creating a conducive climate for a constructive dialogue - which acknowledges a diversity of views - can be regarded a key challenge faced by facilitators during PRA sessions (Chambers, 1994). Issues, such as the existence of power structures within communities or among participants, are challenging the facilitators who try to establish genuine relations between themselves and the participants (Smith et al., 2010). Thereby, it should be remembered that, under any circumstances, the researcher will not be able to disentangle from the setting and act neutral (Kemmis and McTaggart, 2005). While traditional research approaches see scientists as outsiders, PRA acknowledges the researcher as being an active element of the researched system (Webber and Ison, 1995). Therefore, Chesler (1991) argues that research should be sensitive to context and participants, as well as the interaction of both with the researcher. In this manner, trust between participants, accountability, commitment or joint development should become principles of the research process (Chataway, 1997; Kemmis and McTaggart, 2005). Within this process, one aims to achieve participant self-mobilization (Sevilla, 2006); however, when responding to this, researchers face certain obstacles. Cornwall (2008) points out that being involved in a process is not equivalent to having a voice, as hindering factors (e.g., fear of

reprisals or the expectation of not being listened to or taken seriously) might result in participants being unable to express themselves (Cornwall, 2008). By recognizing powerful, multi-dimensional and (in many instances) anti-participatory forces that dominate the lives of rural people, one will realize that

“centuries of domination and subservience will not disappear overnight just because we have ‘discovered’ the concept of participation” (Oakley, 1995: 4).

Therefore, facilitators can only achieve empowerment to a certain extent within specific environmental conditions (Cornwall, 2008).

This shift in scientific paradigm goes back to the evolution of postmodernist and postcolonial anthropology: specifically, the critics of dominating Westernized narratives and totalizing paradigms that regard subjected local communities as a mere source of data (Kesby, 2005).

Action research is originated in the 1950s, in line with the social psychology work of Kurt Lewin (Bradbury-Huang, 2010). The origin of PRA can be traced back to the 1960s as a response to postcolonial developmental reflections (Cornwall and Pratt, 2011). These participative approaches to research are drawn from pragmatic philosophy (Greenwood and Levin, 2006), critical thinking (Kemmis, 2001), liberationist thought (Selener, 1997), humanistic and transpersonal psychology (Heron and Reason, 2006), constructionist theory (Ludema et al., 2001), systems thinking (Flood, 2010) and complexity theory (Reason and Goodwin, 1999).

Campbell (2002) raised the concern that methodological issues are clearly overlooked by the postmodernist trends of research. By rejecting the objectivity of scientific methods, alternative methods often would fail to provide transparency and accountability in their procedures. In Campbell’s view, these shortcomings are, for example: unclear sample selection procedures, missing preparation to obtain homogenous and comparable answers and the influence of the researcher as a facilitator on the research outcomes (such as in the capacity of a group discussion moderator). Similarly, participative research approaches have been criticized by other authors (e.g., Baxter

and Eyles, 1999) and Bailey et al. (1999: 171) provide the following response by advocating for the use of a dialectic logic, as

“this logic explores the relationship between happenings and objects in the material world and their subjective representation in human consciousness”.

In other words, social scientists must consider that reality cannot be disentangled from previous experiences (Webber and Ison, 1995), nor the sensemaking of agents, as human community involves collective action based on mutual sensemaking (Reason, 2001). Representatives of action research have distanced themselves from the positivist view: that mind and reality are separate and the rational human drawing on analytical thought and experimental methods can come to know the objective world (Harvey, 1990). We start from the position that is well-argued elsewhere (e.g., Reason, 1994), that this positivist worldview has outlived its usefulness; as Habermas (1993) announced, modernism is dead. Therefore, reflections on the circumstances that govern the relations of the involved actors and how conclusions are inferred are valuable in themselves. Thus, critical enquiry is an essential task for researchers; they must be aware of the implications entailed by using different methods in the frame of power relations, as well as the historical and social context. This process and the resulting implications must be thoroughly accounted for when researching (Bailey et al., 1999).

Deciding on an action research approach

After deciding upon the initial research question, I realized why this question was so crucial but unanswered: when asking indigenous farmers “Why are farmers not applying eco-efficient methods they learnt about?”, they simply responded that they are too lazy and do not understand the instructions. It seemed to me that here the ascriptions of indigenous being lazy and stupid, often applied by Khmer locals in the discourse about indigenous farmers, had become self-ascriptions. Another answer often received was that farmers simply do not know the reasons behind the lack of application; this gave the impression that there was a barrier in place that prevented one from encountering the real reasons. Perhaps there are hidden reasons which are unspoken, due to two factors. The unspoken hints are the result of hidden reasons

– i.e., because of the expected non-understanding of outsiders – or are caused by the irrationality of complex negotiation processes rooted in cultural transformations. These reasons highlight that trust must be built up in the researcher’s intentions, while respect should be generated and there should be an appreciation of the emic perception. Therefore, researchers should find methods to deal with these possible unspoken reasons. In this study, I decided to observe learning processes and attempt to develop an understanding of how farmers reflect upon them.

First, I decided to facilitate a collaborative learning process that would be driven by the way farmers decide to learn the terms of action research. Second, I took the decision to observe, and initiate evaluations of, training given by local agricultural extension actors; it was assumed that this would give me the opportunity to indicate differences in the way indigenous farmers and extension actors transfer knowledge in order to understand potential reasons for non-adoption, which is caused by the way in which eco-efficient methods are taught. Moreover, it provided the opportunity to understand how farmers perceive and reflect on eco-efficient methods, based on concrete reactions towards them; indeed, this enables one to formulate ideas which can then be developed and tested further using semi-structured interviews and group discussions.

5.4. Overview of the action-research process in this study

The project for this thesis is based on the outlined principles of the discourse described above and has been organized according to the suggested action steps provided by Christinck and Kaufmann (2017). Figure 2 illustrates how the action steps suggested by Christinck and Kaufmann (2017) have been conducted within this project.













	Christinck and Kaufmann (2017)	In this study
1.	Stakeholder analysis 	First period: Explorative period (Multi-stakeholder analysis) 
2.	Institutionalization of the collaboration 	First period: Explorative period Sampling of villages and forming of groups of participants while also identifying facilitators 
3.	Situation analysis 	First period: Explorative period Identifying research question 
4.	Agreement on goals and priorities 	Second period: Collaborative learning process Participative video making 
5.	Learning and action to identify solutions or improved practices 	Second period: Collaborative learning process Participative video making Farmer-to-farmer teaching 
6.	Implementation of identified solutions or practices 	Third period: Experiments Farmer-led field experiments with organic fertilizer taught in farmer-to-farmer teaching 
7.	Monitoring and evaluation	Second period: Collaborative learning process Steadily conducted process immanent participative monitoring and evaluation Fourth period: Planning Evaluation of observation during the field experiments Development of a shared vision and project idea

Figure 2: Steps of conducting an action research process. Modified source: Christinck and Kaufmann, 2017

As elaborated in Figure 2 following them, at the first stage, the multi-stakeholder analysis and identification of participants should be a multi-perspective assessment to ensure the inclusion of all key stakeholders. In this project, the process of analyzing and identifying stakeholders was undertaken in several steps by narrowing down a general definition to a more detailed characterization. Based on the target groups, indigenous small-scale farmers “formulated by the overall project framework of the CIAT program” Hands and Mind connected to boost the eco-efficiency of smallholder livestock-crop farms” and a more detailed understanding of the small-scale farmers could be gained during the explorative period. Accordingly, it was possible to focus on indigenous small-scale farmers and to formulate a hypothesis which made it possible to sample participating villages (see “Sampling” chapter). As a next step, according to Christinck and Kaufmann (2017), groups should be formed, and procedures should be set up to implement collaborative learning processes; this should allow for an analysis of the situation so as to ensure a mutual understanding of the context, problems and trends, as well as the important factors of the problems raised. In the present project those steps were undertaken in an explorative period during which stakeholders were invited to discuss the main problems and solutions. During this process the overall research question was identified (see “Identification of research question” chapter). To identify a point for further activities, researchers and stakeholders should, according to Christinck and Kaufmann (2017), agree on common goals and priorities. These further activities could be: joint experiments, farmer-to-farmer exchanges, case studies to complete information gaps, assessments of new information and training in new technologies or practices to co-learn and develop solutions to the issues. Thus, the developed solutions should be further evolved with ongoing experiences and refinement. In the present project, those steps were undertaken during the collaborative learning process by facilitating participative video making, farmer-to-farmer teaching (see “Collaborative learning process” chapter) and field experiments (see “On farm experiments” chapter). The last step allows participants to jointly reflect upon learning processes, analyze the outcomes of a solution, and change the

actions in the future if necessary. Those reflections were facilitated throughout the collaborative learning process. Furthermore, during the last period, the evaluation of the field experiments and the development of a future project idea were facilitated. Christnick and Kaufmann (2017) suggest that, in each of these steps, contextuality is of vital importance. This recommendation was implemented as an iterative process by accompanying the collaborative learning process with merged scientific methods in order to more deeply embed the contextual understanding.

The whole action research had been formulated from a mixture of various methods which were merged and intertwined. The selection of different sources of information and data collection methods was guided by the principle of 'triangulation'. This enabled cross-checking in order to ensure the independence of one type of person, or one source of information, or one set of tools. Applying multiple methods strengthens the validity of the findings derived through certain qualitative research methods (Denzin & Lincoln, 2000). This was based on the idea of Grounded Theory being an iterative research process: for example, one theme came up while creating a movie together with participants. This theme could be refined by interviewing other indigenous farmers not participating in the collaborative learning process, who might offer different perspectives or confirm the discovered theme. Here, a second very important aspect of the research based on Grounded Theory kicks in: constant comparison as a central principle of data analysis. As issues of interest are noted, interviews and group discussions were conducted in order to be able to evaluate and relativize in comparison similarities and differences. Through the process of constant comparison, emerging theoretical constructs were continually refined. This goes hand in hand with the idea of conducting data collection and analysis simultaneously. Therefore, the action research process can be described in loops of diagnosing, planning action, taking action and evaluating action, as is shown in Figure 3 (Coghlan and Brannick, 2001). Thereby, all of those steps were undertaken in a participative manner with the participants of the collaborative learning process to ensure that their perspectives, ideas and needs were taken into account.

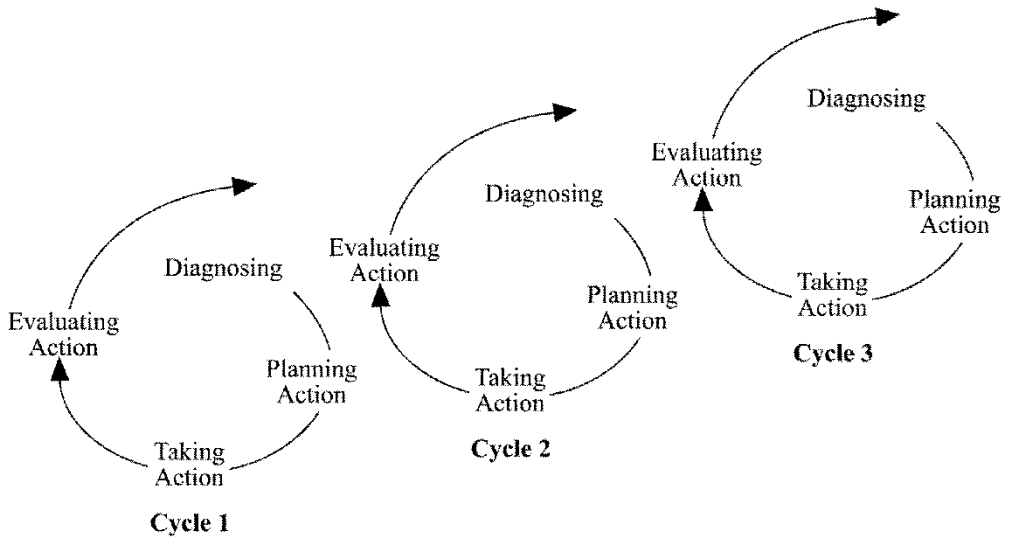


Figure 3: Coghlan and Brannick, (2001), Spiral of Action Research Cycles [ONLINE]. Available at: https://www.researchgate.net/figure/Spiral-of-Action-Research-Cycles-Coghlan-and-Brannick-200119-Cycle-2_fig1_26466364 [Accessed 17 July 2018].

In terms of how the different methods were merged, I will outline this in detail by describing the different research periods. Table 1 gives an overview of the methods applied in the different time and research periods.

Table 1: Own Collection. Combination of methods in different research periods

Time period	April (since 17 th)	Mai	June	July	August	September
Research period	Exploration	Collaborative learning		Experiment		Evaluation
PRA tools	X					X
Participative video making	X		X			X
Semi-structured interview	X		X			X
Biographical/ Narrative interview	X		X			
Ethnographic interview	X		X			
Informal conversations	X		X			X
Problem oriented interview	X		X			
Confrontation interview			X			
Group discussion	X		X			X
On farm field experiment					X	
Participative observation	X		X			

Each activity conducted within the action research entailed a specific mix of those methods. How each method was applied within activities and combined with other methods is described more in detail in the following chapters.

To give an overview about the activities conducted within this study I will summarize the activities in the category's workshops, interviews, group discussions, field visit, movie showing events and on farm field experiments.

In total twelve villages had been involved in the process and around hundred-thirty indigenous farmers. Thereby villages thirty-four persons were involved in participative video making project. As table x below lists, the project consisted in total of sixty-nine individual interviews and twenty-four group discussions. Additionally, the collaborative learning process facilitated entailed 6 workshops conducted by farmers for farmers to learn organic fertilizer, 4workshops conducted by farmers for farmers to learn natural

pesticides and one workshop conducted to discuss the feasibility and desirability to produce organic fertilizer for other farmers. Furthermore, one field visit of a farmer who applied eco-efficient methods since several years was conducted and involved all four villages participating in the participative video making process with twenty-five participants.

Moreover, one final movie event for sixty local stakeholders respectively farmers, local NGO extension actors and employee of the department of agriculture and village movie showing were conducted. Beside many field trials which were not followed up within this study seven farmer led on field trials were conducted by farmers and had been evaluated by the farmers. At the end of the research process one evaluation meeting took place with ten key farmers of the participative video process and employee of three local NGOs working on sustainable agriculture (CEDAC, ETEA,SVC) and the department of agriculture.

5.5. Research periods

In this chapter the four periods of this research process will be elaborated in detail. It will give an insight about the activities conducted within and the reasons to choose them as well, as the methods applied. Furthermore, it will shed light on how each step action step was building up on each other.

5.5.1. First period: Explorative period

In this chapter it will be explained how the research question was identified and elaborates the tools applied for this identification process. Secondly it is elaborated how the translator and facilitator had been chosen and how the participants had been sampled of the overall study and in particular for the participative video making process.

Identifying the research question

To be able to identify a research question, I assumed entering the field would first be necessary; in doing so, the opportunity was given to

explore which research question would be important for local actors with regards to boosting eco-efficient methods. For this reason, two workshop days were attended, organized by CIAT project leader and one Khmer scientist of the Cambodian Royal University of Agriculture. At these workshops, the facilitators investigated together with local farmers (Khmer and indigenous); these local extension actors perceived problems and suggestions about how they could be targeted were collected. By using semi-structured interviews, this allowed for a deepened understanding of certain aspects and I could develop ideas for research questions; these ideas were then discussed with local extension actors, farmers and the CIAT project leader. Moreover, it seemed crucial to develop an understanding of the context before formulating the research question; it was crucial to develop an encounter of socio-cultural and ecological dimensions. To ensure a participative approach from the beginning in an iterative process, the second explorative period I constituted by applying PRA tools; such as the problem tree, rich picture, group discussions and timeline together when meeting with farmers. In addition, individual interviews were conducted.

PRA tools applied to identify the research question

PRA tools were mainly applied in the explorative period accompanying narrative interviews and group discussions.

Problem tree

Problem analysis has been applied to investigate together with primary stake- holders key causes and effects of the problems they are facing. It involves drawing a problem tree as demonstrated in Figure 4 (WAN, 2012). Therefore, a web of interdependent causes and effects are reflected in order to understand in a holistic way route causality leading to main problems the indigenous farmers are facing in Ratanakiri.

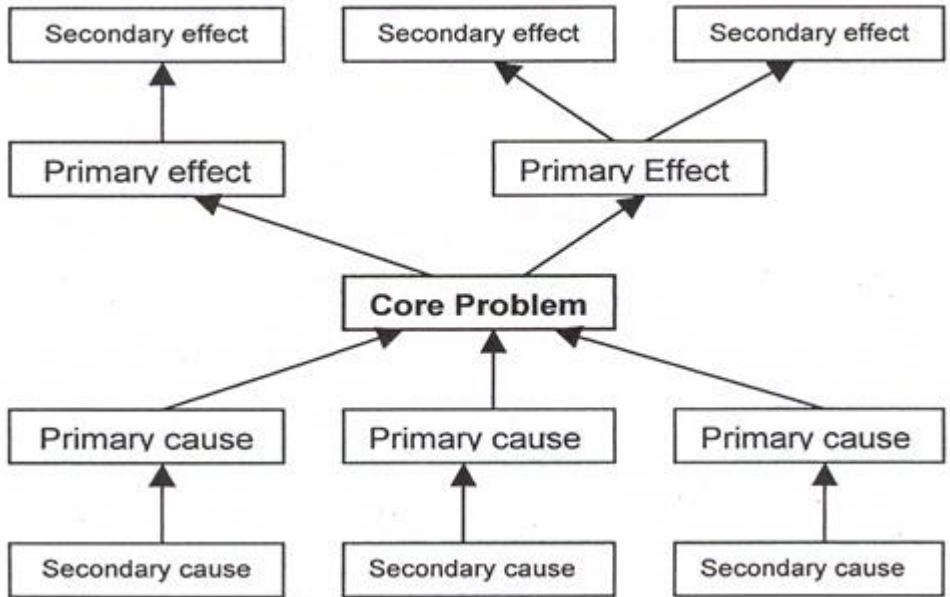


Figure 4: World Animal Net (WAN), (2012), Problem tree [ONLINE]. Available at: <http://worldanimal.net/our-programs/strategic-advocacy-course-new/advocacy-toolkit/31-uncategorised/244-2-causal-mapping-or-problem-tree-analysis> [Accessed 26 April 2018].

Rich picture

For understanding the indigenous farming system and the emic perception of it, farmers were asked to draw rich pictures of their farms. Howard and Monk (1998) defined the method rich picture as

„A rich picture is a drawing of a situation that illustrates the main elements and relationships that need to be considered in trying to intervene in order to create some improvement. It consists of pictures, text, symbols and icons, which are all used to illustrate graphically the situation.“

Timeline

The method timeline was applied to investigate with indigenous farmers together their history and the emergence of recent challenges they are facing. It served to understand their emic perception and

interpretation of their history. Thereby the focus was on changes in their agricultural practices.

As suggested by Cavestro (2003) in order to conduct a timeline a group discussion was facilitated in which the most important events in the community's past were discussed. Afterwards this timeline with basic events was used like suggested by Cavestro (2003) for discussions on problems, social and technological innovations and on community's history.

Sampling of participants

The next step involves formulating groups of participants. The search had already started within the explorative period while conducting group discussions, PRA tools and interviews. With the help of these methods, an insight could be gained regarding some characteristics of the villages, how they differ and which problems each are facing.

Institutionalization of the collaboration and sampling of stakeholders

In this chapter it will be elaborated who was involved in the research process, their characteristics, the reason for having chosen them and their role within the study. The groups are divided into the group of participants, which are the indigenous farmers involved in the research process; the translators and finally the NGOs collaborated with.

Characterization of Participants

In total hundred-thirty individual indigenous farmers were involved in this research. One can divide them into two main groups: One group which participated in the Participative video making project respectively the collaborative learning process and one which constituted the reference group which only participated in group discussions and interviews. They stayed in twelve different villages and belonged to the seven different ethnic groups Tom Poen, which is

the largest group (in 2013 estimated to be 56,800 (MOP, 2013)), Jorai, Brao, Kreung, Kraveth, Khmer and Bunong. Thereby, Tom Poen constituted the biggest group of participants followed by Kreung and Brao. The location of those villages covered all districts of Ratanakiri except Andoung Meas and Bar Kaev. Nevertheless, the four villages involved in the participative video making process were for logistical reasons located close to the district capital Banlung. These districts were Banlung and Ou chum.



Map 4: Wikipedia, (2008), Map of Ratanakiri Province with districts outlined [ONLINE]. Available at: https://commons.wikimedia.org/wiki/File:Ratanakiri_districts.jpg [Accessed 16 May 2018].

It can be assumed that the percentage of women was as high as the percentage of men in total. Nevertheless, the percentage of women respectively men joining the meetings differed from village to village: In some villages a higher number of women joined and in others more men. This can be reflected in terms of peer group dynamics, meaning that women are inviting women to join and men are inviting men to join. The participants age ranged from fourteen years to sixty years and was relatively equally spread.

For the participative video making process four villages were chosen. The four chosen villages differed in their distance to the market in Banlung and in their degree of rainforest disappearance. Furthermore, the villages differed in the degree of abundance of traditional rice varieties, the adoption of cashew plantations, the influence of Khmer culture and the usage of pesticides. Finally, they differed in the contact they have had with local agricultural extension actors respectively in their previous learning about eco-efficient methods.

Characterization of the four villages

Village 1

The journey to Banlung from Village 1 one takes approximately one hour on motorbike; many residents rely mainly on subsistence farming. Many families still cultivate in the traditional intercropping system in the uplands, farming traditional rice and vegetable varieties. Ceremonies can be perceived as an integral part of life. The village is surrounded by villager-owned rice fields, cashew and cassava plantations, and each household has a vegetable garden. Herbicides are only randomly used in the cashew plantations. The village is often targeted by agricultural extension actors and programs in which farmers are informed of organic fertilisers, dry season vegetable cultivation, livestock keeping and land titling. However, the villagers reported that none of the farmers who learnt about organic fertiliser are applying it.

Village 2

Village 2 is approximately 30 minutes from Banlung on motorbike and is the village of the model farmer and his son-in-law. Many families still grow traditional rice varieties in the conventional intercropping system in the uplands. Ceremonies are an integral part of everyday life. The village is surrounded by villager-owned rice fields, cashew and cassava plantations, and each household has a vegetable garden. Also, this village has a maintained rainforest for which it holds its own land title. Herbicides in cashew are seldom applied. Villagers have been subjected to agricultural extension actor teaching programs regarding organic fertiliser, SRI and dry season vegetable cultivation. Most

farmers are applying organic fertiliser in their vegetable gardens, but not in the rice fields; SRI is only applied by the model farmer.

Village 3

The village of Lon is the closest of the chosen villages to Banlung; it only takes around 15 minutes on a motorbike. There is no rainforest left to conduct a shift cultivation; only a nature reserve around the famous resort for tourists called Lake Yeak Laom remains. The village is enclosed by rubber tree plantations and the cashew plantations of the villagers they abandoned to cultivate the traditional intercropping system in the uplands. Nowadays, they are cultivating rice in swamp land on which it is impossible to cultivate other crops. The villagers have had some experiences with extension actors; they expressed being frustrated with them and articulated being disappointed as they did not learn any useful methods. Also, one woman joining the group of participants had worked for an NGO before, but she did not apply any of the agricultural methods she learnt.

Village 4

Village 4 is a village around one-hour distance from Banlung. No rainforest remains around the village and farmers have nearly fully abandoned cultivating rice. Instead, they started cultivating monocultures of vegetables and cashews, while some grow fruit trees, such as bananas, in monocultures. Villagers are reportedly heavily using pesticides due to serious pest problems. Some farmers were made aware of organic fertiliser and natural pesticides in earlier teaching programs but did not apply them. For example, one participant was told of several organic fertilisers and natural pesticides but did not apply them nor inform other farmers. Half of the village's population are Khmer and the other half are Tom Poen.

Identifying participants for the participative video making

Crucial criteria for selecting the right participants was the intrinsic motivation of joining the project. In this region, it is normal to be paid money for participating. However, I decided against as it would undermine the development of a self-driven collaborative learning process. There is a potential draw back given by the inherent

precondition of this study's approach to finding participants: due to the enacted approach when searching for participants who will join the project for intrinsic reasons, it is probable that only participants who share an interest in learning about eco-efficient methods participated in the project. This would imply that the investigation would be at risk of missing out on key information as to why some farmers are not interested in eco-efficient methods. To ensure that this will not be the case, it was ensured that the farmers participating had previously learnt of eco-efficient methods and decided not to apply them. In fact, most of the participants who entered the project had previous experiences of eco-efficient methods and, therefore, it was possible to gain important insights into their emic reflections about their learning experiences previously, their reason for not applying the methods and why they decided within this action research project to decide to do so. Also, some farmers who participated in the action research project decided afterwards not to apply; this offered the opportunity to investigate their reasons. Many semi-structured interviews were conducted with farmers who did not participate in the action research project to relativize the insights gained and this selection's effect. Furthermore, one can say that farmers who are were not at all interested in learning about eco-efficient methods were not the targeted group of this investigation, since the research question investigated the reason why farmers are not willing to apply the techniques after learning of them. The size of the groups varied over time and in each village: in La En Kren, there were 12 core persons; in La En Chaun there were five; in Kroch, there were 13, and; in Lon there were seven. When factoring in gender, it depended upon the facilitator: in La En Chaun they were mainly male; in La En Kren and Lon the majority were female, and; in Kroch there was an equal gender distribution. Therefore, when those groups were meeting, there was often an equal number of males and females. It was important in this instance that participants felt comfortable expressing themselves whether they were a woman or a man; it seemed to be beneficial to let them choose themselves with who they wanted to group with. The emerged composition of both female- and male-dominated groups, and their difference in composition when meeting each other, offered the chance to observe potential gender differences.

The role of village facilitators

To find a group of intrinsically-interested persons within each of the four chosen villages, it was important to announce the facilitators. The official method, or the conventional communication channel by extension actors to collaborate with villagers, was to ask the community chief to call the village chief. However, it was realised that this method might also undermine the intrinsic motivation due to individuals feeling forced. Bearing in mind the discriminating history of indigenous, it was decided to choose alternative methods. These alternative communication channels were farmers who had a good social reputation but no official political position; they were motivated to take over this role. One needs to remember that the selection of facilitators was to determine that the participants - to some extent as facilitators - were invited based on personal preferences, such as peers and the people they have a good relationship with. For instance, one farmer selected mainly young people because he was convinced that they are the ones to bring about change. Another farmer invited her friends, which were mainly women; however, this equalised the selection as some male members of the invited households also opted to join.

Farmer to farmer teachers

The primary teacher was an indigenous farmer who took over the role of the model farmer; he had a successfully cultivating mixed fruit garden with vegetables, cashews, a system of rice intensification and traditional upland rice cultivation by applying a wide range of eco-efficient methods. Those eco-efficient methods were traditionally not applied in the fields of indigenous and included natural pesticides and organic fertilisers, such as EM-fertiliser. When searching for a potential model farmer, the indigenous farmer himself suggested that the researchers visit his farm. On the first visit, a narrative interview was conducted in which he discussed how he learnt about eco-efficient methods; he offered a tour of his farm and explained the main eco-efficient methods he was applying. This farmer agreed to share his knowledge to other farmers, together with his son-in-law who he had taught and who was now also applying those methods. These two farmers were quite famous in the area for their agricultural methods within the indigenous farmer community, as well as with extension actors.

Beside these two model farmers, other participants of the project became farming teachers during the study; this shall be described in the following section about participative video-making process.

Identification and characteristics of translator

During the first six weeks of residency, I sought for a reliable translator. One hindering reason to find a suitable individual was the high level of language necessary for this kind of research, as it would require a precise and differentiated translation to investigate the emic perception. Moreover, discriminating ascriptions of stupidity and backwardness towards the indigenous population from potential translators was an additional blockade for participative action research that aims to empower farmers in the role of experts. In the end, three suitable translators were found: a man who belonged to the targeted indigenous group, Tom Poen, who was founder and manager of a non-governmental organization for indigenous rights who also conducts videos; a Khmer woman with a high level of English who is skilled in facilitating workshops, commitment and comprehension of the project idea, and; a local Khmer man with a high level of English and a good established network. Conducting research with one member of the indigenous group could be seen as a 'door-opener' to potential participants; it could build trust and allow entrance into topics which are 'hidden' to outsiders. Unfortunately, the time limitations of the Tom Poen man made it impossible for him to take part in the entire time-intensive investigation. Therefore, I decided to work with the Tom Poen man to build up a network of participants and to commence the project together with him and the Khmer translator. In addition, the Tom Poen man was conferred with when we reached the bottom of the Khmer language and there was a sensitive underpinning to a topic hidden from the Khmer translator (meaning interviews about sensitive topics). Even when facilitating the main part of the workshops together with the Khmer translator, I asked farmers to conduct most of the participative movies with the Tom Poen man. One the one hand thereby it was granted that neither I nor my translator could understand them, and farmers could feel more unobserved and therefore free in conducting the videos and owning the content. At the same time, as it was recorded I could hand over the recordings to my indigenous translator. As an insider of the culture, the Tom Poen man

also served as a discussion partner when needing to evaluate and test the hypothesis. In the Khmer translator, a real companion was found for the project. Being a team with a high level of trust in each other and a shared aim was very important for the project, since a mutual understanding of each other is crucial to facilitate participative workshops in which sensibility towards the situation - such as social-dynamics - are necessary.

The role of collaboration with local NGO

In addition, the translators building up relationships and networks with local extension actors was fundamental for this project. Particularly, the collaboration with three local NGOs (CEDAC-Cambodian Center for Study and Development in Agriculture; ETEA-Foundation for Development and Cooperation; CIPL-Conserve Indigenous Peoples Languages Organization), one representative of FAO and the governmental department of agriculture enabled this project to be conducted in a different manner, such as building up contacts with the organic farmer and farmer groups etc.

5.5.2. Second Period: Collaborative learning process

Participative video making

To introduce into the collaborative learning process giving an understanding of the key method used is essential. This method is called participative video making and will be outlined in the following. Johansson et al. (1999:35) defined Participative video making (PV) as:

“(...) a scriptless video production process, directed by a group of grassroots people, moving forward in iterative cycles of shooting-reviewing. This process aims at creating video narratives that communicate what those who participate in the process really want to communicate, in a way they think is appropriate.”

Therefore, one can say that in this regard it is a specific video production in that it constitutes a participative process in which targeted groups are taking the decision about the process of production, what to show, what to film, who to film and what to edit (Montez, 2014). During the process the group is orientated by a facilitator (ibid.). Therefore

“To a great extent, participants are free to steer the production of images in the direction they regard as more substantial or relevant from their own perspectives” (Berardi and Mistry, 2012).

It has to be mentioned that PV is known under different names. Just to give some: community video, alternative video, grassroots video, process video or direct video.

Literature on participative video making (PV) shows that participative video making is not just a tool for research but an approach towards change-creation.

“Participatory video is the use of video within groups for change, whether it is individual or societal” (Okahashi, 2000: 1). This is widely regarded as the core of PV (White, 2003).

Montez (2014) supports this by pointing out that PV is a participatory visual methodology which can encourage a dialogue to promote and preserve solutions in local communities.

Nevertheless, PV is not limited to one approach or perspective, rather it finds application in many different areas (High et al, 2012): It is applied to conduct research (Oliver et al, 2012), to influence policy making (Wheeler, 2012) or to raise awareness for local issues (White, 2003; Plush, 2012). Boni und Millán 2016 points out that this implies that there is no correct application of PV. Rather the process and outcomes are contextual (Shaw, 2013).

Thus, the application of this research tool differs for each study as its methods have to be adjusted to specific research questions/aims, targeted group and context.

The history of participative movie making:

In 1967, Donald Snowden, director of the Memorial University of Newfoundland (MUN) Extension Program and filmmaker Colin Low had the idea to produce a movie together with fishermen of the Fogo islands (Montez, 2014). This well-known project called “Fogo

process” gave rise to many imitations and could be regarded as the birth of participative video making.

Snowden describes the reaction towards the produced movies like this:

“By watching each other's films, the different villagers on the island came to realize that they shared the same problems and that by working together they could solve some of them. The films were also shown to politicians who lived too far away and were too busy to actually visit the island. As a result of this dialogue, government policies and actions were changed” (LUNCH, 2006: 11).

Conclusive the ideas inherent to PV to empower for change was achieved by encouraging local activism and beyond sharing messages (Montez, 2014).

Nowadays a growing audience is acknowledging the potential of PV to empower change.

“I saw with my eyes, brain and heart, the efficiency of this tool in helping document and transfer information to groups and communities. Information that, in the end of the day, translated into more food on their tables. That’s when you begin making a difference, even if a small one [...]”(Baumhardt, no date: 2).

The statement of the PV activist and Pro Planeta director Baumhardt (no date) demonstrates belief in this method as a tool for change. Below I investigate the various reasons for the use of this method.

PV sets an impulse for self-reflection

Servaes (2007) argues participants “gain an understanding of their situation, confidence and an ability to change that situation”. How this could happen Huber (1998) explains by a therapeutically effect.

“Video is used to develop participants’ confidence and self-esteem. By recording their own stories and seeing them played back, participants can see through video, used as a mirror how they are perceived by others “(Harris, 2008: 5).

This reflexive experience can lead into empowerment for political action (Harris, 2009).

The potential of the opportunities offered by this effect can be especially interesting for stigmatized social groups. Giving ‘voice’ to people who are used to being ignored can for example tackle shame and raise awareness under members of stigmatized groups to be agents and not objects (Buchanan and Murray, 2012).

Besides PV can be regarded as learning medium for gaining media and technological competencies and put into use analytical and communicative skills (Harris, 2009). Moreover, creative production skills, analytical skills in reading mass-media texts, and a deeper understanding of their own communicative potential should be obtained (Riano, 1994). Therefore, PV is claimed to empower in itself (Harris, 2009; Riano, 1994).

Empowerment on a community level

On an interpersonal level, it has been observed repeatedly that PV can foster dialogue and thereby instigate change and empowerment in communities or groups (Harris, 2009). Incidentally, participatory methodology is claimed to boost debates and negotiation processes and promotes communitarian identity (Gumucio-Dagron, 2002). Meanwhile, it is described that individuals find themselves during the PV confronted with social structures within their groups and communities respectively (Richardson-Ngwenya, 2012; White, 2003, cited in Harris, 2009). Thus, reflections are initiated about needs and benefits derived from group belonging and new personal encounters about relations within a group can be generated. Becoming aware of commonly unarticulated aspects could lay the foundation for creativity and communication (White, 2003, cited in Harris, 2009). Additionally, participants can be rewarded by a sense of achievement and with pride about having commonly shared their story (Richardson-Ngwenya, 2012). This in turn can trigger a process of personal, social or political change (White, 2003, cited in Harris, 2009). For example, it could reshape intergroup relations (Richardson-Ngwenya, 2012). Therefore, providing an avenue of thinking and behaving differently could be the basis for a transformative process (High et al., 2012). Harris (2013: 10) noted based on her PV with rural women in Fiji:

“[H]aving found their voices, the women were keen to use video to capture the ‘impressions and expressions’ of their daily life to effectively communicate their hopes and aspirations to the world”.

She concluded that PV can break down gender and economic stereotypes and therefore induce new self-ascriptions of communities. Likewise, re-codifying established norms can bring about stronger ties within communities. As a consequence, PV can be regarded as tool to initiate community building in terms of a “force towards a more participative society” by enhancing dialogue and cooperation (White and Patel, 1994). Along similar lines, Shaw (2015: 10) argues “(...) that communities are not static and pre-existent, but that they are dynamic and can surface and evolve through project processes”. If PV would be conducted on a long-term “more inclusive and collaborative relationships within communities” could be stimulated.

Empowering in political discourses

Let us now turn to the broadly discussed potential of PV as a tactical tool to boost social justice and environmental protection (Harris, 2009), meaning induce changes on a political level. Historically spoken PV is useful in supporting processes of public consultation, advocacy, community mobilization and policy dialogue (Kindon, 2003). Subsequently, PV can generate new encounters by offering participants a platform for self-representation. The avenue provided is opening new ways to connect participants to the outer world for instance by overcoming physical boundaries. In consequence PV can have impact in distant places and at different times (Richardson-Ngwenya, 2012). Granted the potential and desirability of an empowering effect Höchner (2015) nevertheless reminds that ‘giving voice’ alone is not enough to ‘empower’ such groups if the structural inequalities remain unchallenged. To illustrate, there is little control over how people receive and interpret the representations we create (Mills, 1997; Nickerson, 1998). Consequently, representations imply the danger to ironically reinforce stigmatization and lead to vulnerability of participants towards their community being blamed of representing a group in an undesired way (Höchner, 2015).

The role of the facilitator

Let us now examine the role of a facilitator within a PV process. Kawaja's describes the facilitation of a PV process as an act of balance:

“The facilitator experiences a constant struggle to find a balance between being directive and letting participants take initiative, between structuring and planning and letting things evolve spontaneously, and between authoritarianism and nondirective dialogical approach” (As cited in Riano, 1994:141).

In order to resolve this tension Braakman and Edwards (2002) suggest that a facilitator should by all mean be ‘content neutral’, despite able to facilitate a process towards a common goal. White (2003) puts it in the words of “enabling others” while “become co-learners in projects”. In brief, the facilitator has to be able to direct in a way that participants obtain ownership of the PV process. In respect to the responsibility of the facilitator to create an empowering environment, Shaw and Robertson (1997) warn that unstructured learning settings have potentially a “disempowering” effect, as they can create a sense of “chaotic and meaningless”. Conclusively, it is the responsibility of the facilitator to maintain focus. In order to maintain focus while initiating ownership by participants’ the facilitator need to develop a personal style to interrelate with people and investigate throughout the process needs and motivations (ibid.). In this sense being responsive is as important as being able to foster group consensus (Richardson - Ngwenya, 2012). This demands an ongoing negotiation between facilitator and participants. Thereby one needs to consider that we cannot escape being part of power relations beyond our encounter or influence. In order to be responsive, the facilitator needs to obtain the flexibility to adapt and change directions while the process, according to the initiative of participants and at the same time staying focused (ibid.). In view of this Mistry and Berardi (2012) advocate a strategy of flexible reaction, accepting deviations from original goals and cultivate sensibility towards opportunities emerging in unexpected scenarios. In consequence participants should experience their potential to bring about changes (White and Patel, 1994). In light of all this participants involvement in the entire message-making process from the choice of topics and issues to the planning and production of media content is crucial (White and Patel, 1994). To recap agency of

individuals is key of the PV, when aiming for awakening one's self-awareness and consciousness about the own situation condensed by Freire (1984) to the term 'conscientisation'. In order to ensure an inclusive environment, facilitators, have to be sensitive towards power relations and socio-cultural characteristics of the target group. Building trust within participants and towards the facilitator is thereby crucial (Goodsmith, 2007).

The use of participative video making to collect data in this study As suggested by several authors, PV making has the capacity to empower on several levels. For instance, on the level of self-reflection (Buchanan & Murray, 2012; Harris, 2009; Huber, 1998; Riano, 1994; Servaes, 2007), on a community level (Gumucio-Dagron, 2002; Harris, 2009; High et al., 2012; Ngwenya, 2012; Shaw, 2015; White, 2003) and in political discourses (Harris, 2009; Kindon, 2003; Ngwenya, 2012). Likewise, PV making proved to be a useful tool for overcoming the superiority/inferiority dynamic observed as a barrier in the communication between extension actors, respectively researcher and indigenous farmers. While playing the role of experts, farmers shared their perspectives of the issues they are faced in discussions with extension actors, such as local governmental representatives and NGOs; for example, threats to their resilience both in terms of their farming system and more broadly in terms of their health (because of pesticide use). The avenue for a dialogue amongst extension actors was for example granted by a movie event in which the several different videos filmed by farmers were shown. These films contained messages they desired to share, recorded problems in their fields, reports on eco-efficient farming, tutorials for eco-efficient methods and an advertisement movie for an organic fertiliser business idea they developed over the course of the study. Moreover, in an emerging knowledge-sharing process amongst farmers, several farmers decided to become teachers for other farmers in their own and other villages; this was done to spread the knowledge gained and to apply the EM-fertiliser and natural pesticides on their fields to conduct self-initiated experiments. To summarise, the PV making proved promising in terms of stimulating participation and creating a fruitful environment for collective learning processes. The dialogues and learning processes enabled by the participative action research approach allowed to gain insights and an understanding of barriers

towards application and encouraging reasons in the emic perception: This collaborative learning process entails a self-reflection of the indigenous farmers on the negotiation processes they are involved in by deciding for or against application of eco-efficient methods. In other words, the process of creating movies, discussions about the scripts and the encouraged learning process gave opportunity to facilitate a self-reflection process. This gave me as a researcher the chance to gain an understanding of the complexity of the negotiation process between encouraging and discouraging reasons. Moreover, as farmers reflected other farmers of their community as opponent respectively as movie watchers, those reflections were mirroring the assumptions and self-ascriptions of indigenous farmers towards indigenous farmers means an assumed communal agreement. However, methods such as message movies also enabled to understand the individual perception of different aspects related to the decision if to apply eco-efficient methods and which aspects farmers perceive as important to this decision. How in detail the different participative videos helped to facilitate the collaborative learning process and how each of them contributed to the collection of data will be outlined in the following chapter.

Participative video making project undertaken

In this chapter it will be described in detail how the participative video making was undertaken in this project.

The Figure 5 below gives an overview of the action steps undertaken.

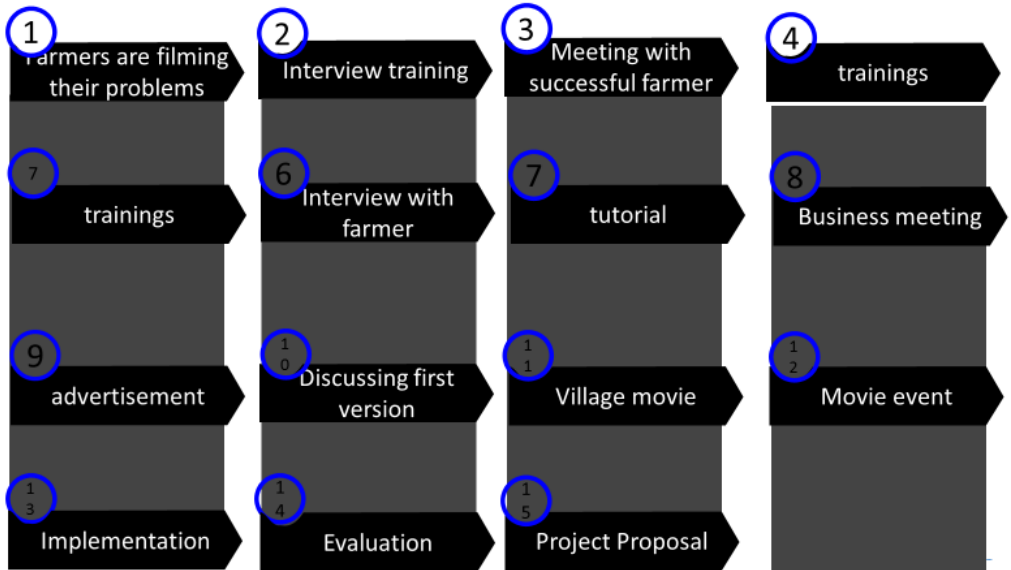


Figure 5: Outline of the participative video making process steps.

Problem finding

After forming the participant groups, farmers were asked to create films that detail the issues they face concerning agriculture. To teach the farmers how to use the provided cameras, workshops were conducted in which they learnt basic technical know-how and practiced filming; the farmers who felt motivated to film borrowed the camera for a select number of days. The collected movies of the problematic issues were then discussed within the participant groups and were additionally shown to local extension actors.

Aims

This video-making activity encouraged debates about the key issues farmers must find solutions for, filled in knowledge gaps and aimed to induce a shared aim - to find solutions. Also, knowledge was generated in discussions and existing knowledge was shared among farmers. Therefore, the essential aim of the process was to foster an intrinsic motivation to participate in a collective solution-finding activity as the driving force for this action research project.

Conducting a reportage



Image 2: Own Collection, (2017), Field visit model farmer and interview

After agreeing with the model farmers, participants were invited to attend a field visit of the model farmer's farm. The aim was to induce knowledge sharing behavior and to establish the model farmer as an expert and teacher of eco-efficient methods. To facilitate this knowledge exchange, it was decided to conduct a participative movie as a reportage. Thereby, the farmers acted as interviewers asking questions of the model farmer.

Aim

The idea behind conducting the reportage was to generate a focus on the solution-finding process, the meaning of the questions and the problems which farmers reflect upon as being important when seeking solutions. Furthermore, the underlying concept was based on the

thought that while creating a film there was a potential audience presented to the interviewer who featured in front of the camera; depending on who was pictured as the potential audience, the interviewer will adapt his questions. It was considered that picturing other indigenous farmers as a potential audience would provide an opportunity for farmers to ask questions relating to their indigenous cosmology; findings otherwise hidden to the researchers in their capacity as ‘outsiders’. Finally, the reportage gave farmers the opportunity to share and discuss their gained knowledge with other farmers in movie showings.

Interview training



Image 4: Participants practicing interviewing. Source: Own.

Before the field visit, the groups of participants from each village were met with to discuss the questions they would like to ask the model farmer; at this stage, they also practiced their interviewing technique.

Aim

To generate a focus on questions concerning the problems farmers are facing, it was important to discuss the questions ahead of time. Also, to ensure that farmers feel safe in their role as interviewers, it was perceived as important to practice first. Moreover, the training sessions offer the opportunity to explain that the idea of creating a movie was to share them with other farmers.

Field visit



Image 5: Recording of the model farm. Source: Own.

The participants of three villages visited the farm of one successful farmer (i.e., the model farmer). In this field visit, the farmers interviewed the model farmer and conducted a reportage. Furthermore, farmers filmed what they thought was interesting on this farm and exchanged plants.

Aim

The aim of this field visit was to offer participants the chance to see a farm that applied eco-efficient methods with their own eyes and to ask any questions.

Teaching of EM-fertilizer



Image 6: Farmer practicing EM-fertilizer. Source: Own.

During this field visit, the model farmers decided to teach the visiting farmers about the production of EM-fertiliser, as described in the chapter ‘EM-fertiliser’; for them, it was important to show the farmers how to produce organic fertiliser using hands-on practice.

Aim

Farmers were taught of eco-efficient methods and organic fertiliser in an indigenous way the model farmer considered to be pedagogically valuable in emic terms; this offered the chance to observe emic concepts and methods of transferring knowledge.

Chain of teaching



Image 7: Farmer-to-farmer-teaching of EM-fertilizer. Source: Own.

Once participants of the four villages learnt about EM-fertilizer, they decided to teach other villagers about the concepts. One farmer even decided to invite farmers from another village and taught two additional eco-efficient methods he had previously been aware of but had not yet shared with others; he stated that the workshop with the model farmer inspired him to become a teacher. In this village, the teaching chain continued further, meaning the farmers who were taught within the follow-up teaching courses decided to go on and teach other farmers in additional workshops. In another village, a female farmer decided to share knowledge of how to produce EM-fertiliser with other villagers. This farmer has previously decided not to apply the eco-efficient methods she had learnt of from teaching programs she attended prior to this study. Now, she presented - even to the village chief - about how to produce EM-fertiliser and chose to apply it to all her fields. The villagers shared the produced EM-fertiliser among one another, even experimenting with it as they articulated. In another village, the participants decided not to produce any EM-fertiliser, but they did opt to buy organic fertiliser following their field visit. With all participants, and within the workshops, follow-up group discussions and interviews were conducted to evaluate the eco-efficient methods they had learnt (i.e., mixed culture, EM-fertiliser and natural pesticides) and their underlying concepts.

To plan for a continuance of the process, the perceived obstacles of EM-fertiliser were investigated. As a result, it was realised that many open questions remained. Therefore, the successful farmer was invited in again to conduct another reportage; the underlying concept is outlined in the ‘Reportage’ section.

Aim

The purpose of the above activity was to encourage the sharing of eco-efficient method knowledge, to reflect upon them critically and to formulate further steps of how to face obstacles in a collaborative process that identifies solutions. Furthermore, it established farmers themselves in the role of teachers to empower them in the role of experts.

Second reportage



Image 8: Participants interviewing model farmer. Source: Own.

Another reportage was conducted in which participants interviewed the model farmer. To prepare for the interview, all questions farmers wanted to ask were collected and they again practiced how to conduct an interview in the same way as they had previously, prior to the first reportage (as outlined above).

Aim

The farmers were being encouraged to be investigators, searching for solutions in exchange with other farmers and to generating new knowledge for the problems they faced. This knowledge could enable

them to apply eco-efficient methods. With regards to the interview recording, it meant the farmer could share their findings with the farmers that did not participate in the workshop.

Teaching session



Image 9: Teaching session about natural pesticides. Source: Own.

The model farmer decided that he would like to teach the participants how to produce natural pesticides; therefore, he conducted a hands-on workshop in which farmers were given the opportunity to practice producing this natural pesticide. Participants from three villages came together to participate in this workshop.

Aim

The aim was to share the knowledge perceived by the model farmer, as it was important to enable farmers with facing the problems they articulated in the interview stage of the second reportage.

Production of a tutorial



Image 10: Conduction of the tutorial for EM-fertilizer. Source: Own.

Some participants decided to produce a tutorial using the filming material that they had collected from the teaching sessions.

Aim

The set emic aim was to share gained knowledge with other farmers. In a pedagogical sense, producing the tutorial also fostered an intensified knowledge in the participants regarding the production of eco-efficient methods.

Business meeting

The participating farmers concluded that it could be a good idea to produce EM-fertilizer and sell it on to other farmers; the idea was to sell organic fertilizer to those who lack the knowledge and motivation to produce the fertilizer themselves. Participants from four villages decided to come together and discuss how they could build up a business, as well as to converse about their concerns of the obstacles they may face. The farmers formulated strategies of how to implement their ideas and to develop an action plan. For moderation and to receive input, an extension service actor who is skilled in setting up business plans was invited in to consult with the indigenous farmers.

Aim

The aim of the business meeting was to encourage self-initiated collaborative action. Also, by producing organic fertilizer and selling it to the market, a new strategy by farmers was developed to boost the application of eco-efficient methods and to overcome knowledge or time barriers. The discussion and expressions of concerns, obstacles and opportunities offered insights into how farmers perceive the EM-fertilizer and a reflection of the barriers to application.

Production of an advertisement movie



Image 11: Discussion of the script for the advertisement movie.
Source: Own.

Realizing that it would be necessary to advertise the product, the participating farmers had the idea to produce an advertisement film. Therefore, a workshop day was set up in which the farmers discussed the advert's content and developed a script. Next, the script was rehearsed, and the filming commenced in line with the script. The researcher serving as a technical assistant, as well as cameraman, while a farmer filmed with another camera.

Message movies



Image 12: Reflection of farmers. Source: own.

Parallel to the whole process, farmers were occasionally asked if they would like to share a message to other farmers or extension actors; they were informed the movies would be shown at the advertisement premiere. Participants and farmers from other villages shared messages in which they reflected upon topics such as the health threats of pesticides, concerns about losing rice varieties and reflections of eco-efficient methods.

Aim

The aim of the message movies was to induce reflections and discussions about topics concerning the application of eco-efficient methods. Moreover, the activity sought to open the avenue for farmers to express their thoughts and opinions in front of an assembly, as they are not often afforded an occasion to express themselves.

Preparation of the movie event

Editing

The movies were edited according to the script developed by the farmers. The videos which did not have a script (e.g., the problem movies or messages) were edited as little as possible. To enable Khmer-speaking stakeholders, such as NGO employees and governmental representatives, the Tom Poen movies were translated to Khmer.

Aim

The aim was to modify the movies as little as possible, so farmers could maintain true ownership of the content. Also, the movies were presented in an attractive way to the assembly to appear professional.

Village showing

The edited movies were shown to the participants and their guests. Afterwards, the versions were discussed, and farmers detailed what elements they would like to change.

Aim

On one hand, the purpose of this showing was to facilitate an occasion in which farmers were able to show the movies to relatives and other villagers. Conversely, it was important to assure the ownership of the content, to discuss with the participants if the movies were how they had intended them to be and how they desired them to be presented at the official movie premiere.

Movie event



Image 13: Movie event. Source: own.

A total of 53 people participated in the movie event: farmers from nine villages, employees from the department of agriculture, the agricultural district leader and four NGOs; the Appendix outlines the program of the event. It was a full day program in which the participants' movies were shown to the audience as a starting point for discussions, knowledge exchange and reflections.

Aim

The purpose of the movie premiere was to be an avenue for farmers to articulate their thoughts as experts in front of extension actors.

Video Proposal

The last step of this project was a meeting after the 2month experiment period (see on farm experiments). In this meeting 10 key farmers meaning farmers who showed a strong commitment in the collaborative learning process were invited. A whole day we were discussing and evaluating the methods taught in the collaborative learning process and how the collaborative learning process should continue. Those suggestions were expressed by 5 farmers who wanted to in a video proposal. The movie was successfully applied to raise fund in order to implement the discussed future steps and continue the collaborative learning process.

Aim

The facilitation of a farmer to farmer exchange was enabling farmers to learn from each other and furthermore giving me insights into how farmer evaluate eco efficient methods. The participative development of future steps is essential in order to formulate project proposals which are meeting the needs of indigenous farmers in this area. But not only the discussions of potential future steps was useful to formulate project ideas moreover it gave me insights what appears crucial for farmers to address with eco efficient methods and how they perceive their potential, their ideas how to overcome barriers to application and the emic identification of knowledge gaps in need to investigate.

Table x gives an overview and summary of the conducted videos within the PV process.

Table 2: Own Collection, (2017), Overview movie conducted.

TYPES OF MOVIES CONDUCTED	
	REPORTAGE interviews with indigenous model farmer conducted by farmers about eco-efficient methods to face their problems
	ON-FARM MOVIES conducted by farmers to share problems they are facing
	ADVERTISEMENT MOVIE created by farmers for promoting organic fertilizer
	SHARED MESSAGES reflections from farmers to farmers
	TUTORIAL explained and demonstrated by farmers how to produce organic fertilizer and natural pesticide
	PARTICIPATIVE PROJECT PROPOSAL

Interviews

As explained above, the research process followed an iterative process in which different methods were synthesized in order to investigate the research question. One of the main methods accompanying the collaborative learning process was the application of different types of interviews. In the following I will outline which different types of interviews were conducted and how they were applied to enable a deeper understanding.

Biographical/narrative interviews

According to Schütze (2016), the conducting of a narrative interview can be broken down into three periods (opening, ensuring/reconfirming, and accounting). In contrast with a guideline interview, in a narrative interview the interviewer is not directing the interview; rather, the interviewed person chooses how to narrate and, in this manner, chooses what is, according to the emic perception, meaningful/relevant and how it can be condensed, as well as which details should be mentioned (Schütze, 2016). The narrative interview has been praised because of its avoidance of guidance by the interviewer; indeed, this provides the openness needed to develop an understanding of the interviewed person's perspective, and aspects not yet discovered but seen as important to the research area.

However, the interviewer decides on the topic or time period which the person will discuss. In this project, the narrative/biographical interview was chosen to investigate indigenous small-scale farmers' perception of changes they have experienced over recent years and the influence of said changes on their agricultural practices. For example, I asked the farmers the simple question of how the situation has changed within recent years for their community. This open question gave me occasion to understand the situation more in depth and to develop the context knowledge needed to develop the research question but also to contextualize themes emerging during the research process. In the explorative period, narrative theme-oriented interviews were used to develop an understanding of the context and the complexity of a web of interrelated issues. In the ongoing process of the action research, the narrative interview also became essential in

terms of understanding learning biographies. Thus, one question guiding the interview was, for example, how the farmers learned about eco-efficient methods. This enabled me to understand the learning process and how the decision to apply eco-efficient methods is connected to didactical settings.

According to Schütze (1984) narration is a resource which contributes to the investigation of new knowledge about social reality. As narration can be understood as subjective theories or interpretation of processes experienced, a deeper understanding can be gained of said theories and processes (Schütze, 2016). Thereby, one must always keep in mind this point. Conclusive narratives are not to be considered as fact, since human memory is selective. Therefore, experiences of others will always remain a black box, as we are dealing with established representations (Galvão, 2005).

The narrative interviews encourage the informant to reconstruct important events in his/her life and the social context. Therefore, the narrative emerges from both the life stories of the respondents and the cross-examined situational context (Jovchelovich & Bauer, 2002). The influence of the interviewer in the narrative should be minimal (Bauer & Gaskell, 2000). Therefore, narrative interviews were mainly used to understand the created narrative of processes in the emic perception of the indigenous farmers, so as to discover their experience of changes.

Ethnographic Interview

The ethnographic interview is emerging mostly spontaneously within informal field research situations. Girtler (2002) thereby aims for an emancipated communication between the researcher and the investigated subject or in other words reciprocity within researcher and investigated subject. Due to this aim, natural all-day life conversations are conducted rather than creating an artificial interview situation. This method was applied throughout the action research process. The reciprocity and the natural emergence of communicative situations appeared essential to investigate sensitive topics. Sensitive topics require trust if they are to be tackled, and for trust reciprocity appeared essential, as the researcher and investigated subjects were meeting as persons in an informal conversation in a constant exchange of reciprocity feedback. Furthermore, the ethnographic interviews served as occasion to discover and gain an understanding of themes

popping up during the participative observation of all-day life activities.

Theme or problem-oriented interview

The problem-oriented interview involves, as the name suggests, the exploration of a problem or theme. According to Witzel and Mey (2004), the problem-oriented interview is based on the idea that the interviewer should become involved actively in the process of generating an explorative conversation by giving feedback to the interviewed person. This feedback could be mirroring, confronting or asking explorative follow-up questions (Witzel & Mey, 2004). Moreover, the conducted action research problem-oriented interviews were crucial to deepening the understanding of themes which emerged during the participative video making and throughout the collaborative learning process.

Semi-structured interviews

Simply put, a semi-structured interview is neither highly structured nor unstructured. The reason for this is the effort needed to balance out two underlying principles: (1) strive to avoid leading the interview or imposing meanings, and (2) investigate explicitly subjective theories through guiding questions (Groeben & Scheele, 2000). Semi-structured interviews were the main type of interview applied in this research project. They accompanied the very dense collaborative learning process, as they made it possible to investigate developed themes within the collaborative learning process.

Moreover, I would suggest that the research principles of the theme-oriented interview and the semi-structured interview were merged. The following is an example of how these methods merged: one farmer acknowledged that while the practice of the farmer led reportage, it is not spirits which make the rice red, but the decreasing soil fertility. This hinted that the belief in spirits plays a crucial role in the perception of human agency regarding the decision to apply eco-efficient methods. Therefore, this idea was followed up on in the theme-oriented semi-structured interviews, during which I asked questions about the connectedness of rice cultivation and the belief in spirit as well as the responsibility of human beings within this concept.

Expert interviews

In the expert interviews developed by Meuser and Nagel (1991), the interviewee is not asked as a person but as an actor within a functional context. This is based on a distinction between layman and expert (Dexter, 2006). However, it is rather difficult to examine or define who can be perceived as an expert; moreover, according to Littig (2008), a concrete definition of what is regarded as expert knowledge can only be formulated within the context of the research question. Indeed, the expert interview, which was also chosen for this project, can be regarded as a modification of the semi-structured interview, but instead targets persons who are thought to have expert knowledge about a specific topic. For example, expert interviews were conducted with indigenous farmers about challenges to apply those methods and the benefits, who did apply eco-efficient methods since several years. Furthermore, interviews were conducted with members of the older circle in the village, considered by indigenous to be knowledgeable about the traditional cosmology. For example, after realizing the crucial role of the indigenous cosmology in the human agency, I identified, together with my indigenous translators, one person of the older circle in the village from one of my participating villages and conducted an interview in the indigenous language with this “expert”. Here it was crucial to use the indigenous language to enable the “expert” to use indigenous terminology, as language also transfers incorporated cosmological concepts. Those interviews needed to be relativized regarding the special knowledge held by the person. This was necessary because special knowledge shapes the emic perception and therefore an outstanding perception can be expected which cannot be regarded as a common view. Nevertheless, the expert interviews presented the opportunity to understand issues more in depth. Moreover, they gave me occasion to ask experts, e.g. the member of the older circle, how they perceive the transformation of beliefs within his village; indeed, this made it possible to gain a meta-reflection.

Systemic interview

Circulating and systemic questions were applied in the systemic interview in order to gain a differentiated description (Schorn & Mey, 2005). This mainly means asking the interviewee to not only answer

the question from his/her own position, but also to imagine how another person might answer. This approach appeared important within the conducted action research in terms of unveiling the reasons which were hidden due to feelings such as being ashamed. For example, it was easier to ask why others who had learned about organic fertilizer chose not to apply it afterwards rather than asking directly why the interviewed person was not applying it.

Group discussions

Gathering collective knowledge and collective truths is the objective of group discussions (Bohnsack, 1989). The discussion of those collective perspectives or experiences is negotiated among the participants, and therefore the facilitator should take care not to irritate the discussion flow by dominating it (Bohnsack & Przyborski, 2007). The negotiation process itself is crucial in terms of building up an understanding (Bohnsack, 2004). Said group discussions were often applied in combination with other methods, such as the outlined PRA tools (problem tree, timeline and rich picture) or initiated by videos produced during the participative video project. In later cases, group discussions were initiated by showing a video and inviting participants to share similar experiences or opinions on it. For this project, group discussions were regarded as important, as they made it possible to observe how collective truths about certain themes are negotiated. For example, during the final movie event a video was shown in which a farmer shared his opinion that there is a need to preserve indigenous rice and to not become dependent on the rice from the market, which is treated heavily with chemicals. This encouraged a discussion on how dangerous pesticides are to health, and the farmers then started to share their experiences with pesticides. Furthermore, they discussed the reasons why they started to apply herbicides and why they were giving up on indigenous rice varieties. This communal reflection gave me occasion to understand the complexity and interwovenness of reasons to abandon or conserve indigenous rice varieties and, moreover, how this complexity is negotiated within the transformation process. Furthermore, group discussions were an integrative part of the participative video making meetings. For example, participants discussed together the script of the advertisement movie. Therefore, conducting the movie together was reason for discussing together and

agreeing on a way to present shared ideas about organic fertilizer and the benefits of it.

Participative observation

The aim of participative observation is to gain a close and intimate familiarity with the targeted group of this action research build up trustful relationships and to learn about the agricultural activities. Marshall and Rossman (1989) define participative observation as "the systematic description of events, behaviors, and artifacts in the social setting chosen for study". It provides the context for development and approval of hypothesis (DeWalt & DeWalt, 2002). In this action research project moderate participation was chosen over an active participation. This means that a balance between being an insider and outsider was established rather than choosing to become a member of the group. The choice was taken as a certain detachment from the community group avoids the risks of going native (Schwartz and Schwartz Gree, 1955). In concrete I was participating in agricultural activities such as sowing and weeding, in celebrating ceremonies, political conferences, food sharing and allday life activities in the villages.



5.5.3. Third Period: Farmer-led on-farm experiments

In this third period of the project, the farmers were conducting experiments on their own farms. More specifically, the participants of the collaborative learning process were applying the organic fertilizer which the model farmer had taught them about. Thereby, in terms of how to apply the fertilizer, and the crops to which the fertilizer should be applied, these decisions were taken by the farmers themselves; this was also the case with the evaluation criteria. Said approach was chosen in consideration of the emic perspective on the effectiveness of organic fertilizer, which was crucial to investigate in order to answer the research question (Rocheleau, Weber & Field-Juma, 1988).

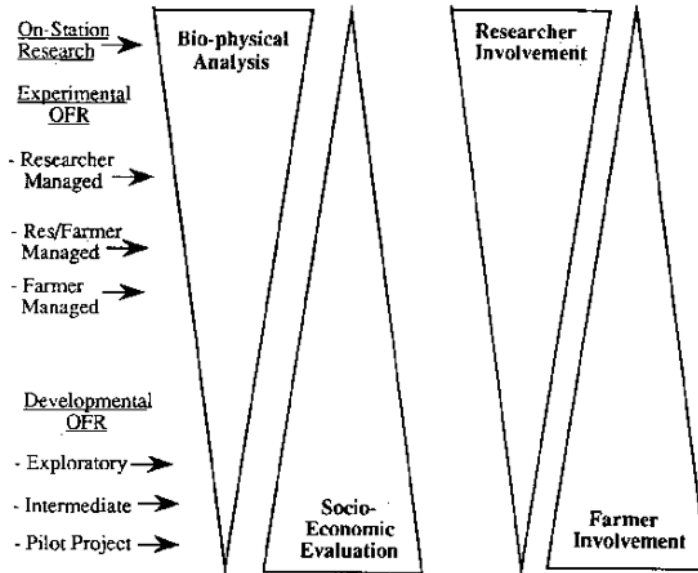


Figure 6: Atta-Krah, (no date), Research objectives and levels of farmer involvement vary in the different types of on-farm research [ONLINE]. Available at: <http://www.fao.org/wairdocs/ilri/x5545e/x5545e08.htm> [Accessed 16 May 2018].

On-farm research needs to be conducted according to the research objectives. Those objectives could be the assessment of a technology for its ecological and technical potential, or an assessment of its feasibility, desirability and potential adaptability by farmers. As shown in Figure 6, the more involved researchers become, the less involved farmers are. The figure also demonstrates that an increasing interest in socio-economic factors goes hand-in-hand with a greater involvement of farmers and is accompanied by a decreasing focus on biophysical factors. Therefore, the interpretation of results from different on-farm research activities needs to take into account the focus chosen. As the focus selected in this action research was the emic perception, an approach was chosen which involved no researchers. More specifically, the farmers shared the EM-fertilizer they produced with each other and experimented with it in the rainy season, respectively applying it to their rice fields, cashew plantations and fruit trees.

In addition, this made it possible to investigate the emic criteria for evaluating eco-efficient methods; indeed, the self-driven application meaning of field trials is an important step to boost the application of eco-efficient methods and to identify gaps in knowledge or hindering factors.

5.5.4. Fourth Period: Evaluation and discussion of further steps

After three months, I revisited the participants; during a whole-day meeting and field visits, the farmers evaluated the effects of using EM-fertilizer. Furthermore, we discussed and elaborated on a strategy with which farmers could continue the collaborative learning process, which problems they want to find solutions to, and the potential solutions. As a last step in this project we produced a participative video proposal in which the farmers expressed why they felt that the project they suggested would be important (see the above description of conducting the participative video proposal). The aim was also to encourage farmers to continue the collaborative learning process as innovators, as well as to produce an important supportive material for

fundraising in order to make the implementation of the project idea feasible.

5.6. Practical Remarks for the Implementation

The study was conducted over a period of six months from April 2017 until October 2017. As Like mentioned earlier and outlined in the Fig 1 the First period was six weeks long, the second period was As shown on Map 3, the province capital Banlung was the research station where I lived during my stay.



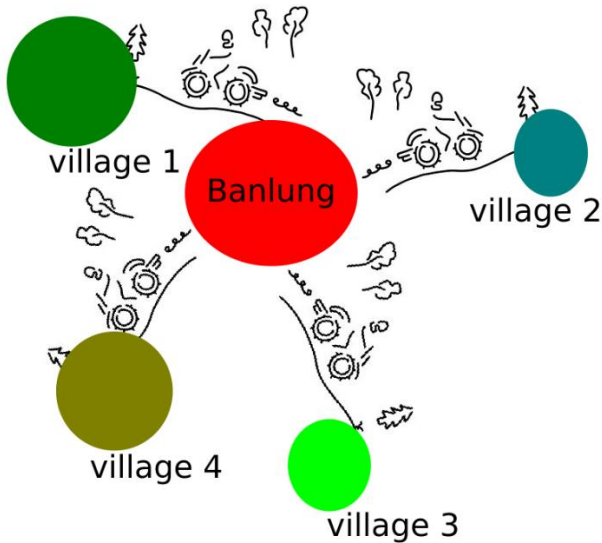
Map

3:

https://en.wikipedia.org/wiki/Ratanakiri_Province#/media/File:Ratanakiri_physical_map.svg

This enabled me to take care of the technical equipment, e.g. charging the batteries for the cameras. I also occasionally stayed with the families of the participants in the villages so as to be able to conduct participative observation and build up relationships. Nevertheless, I decided that the research base should be in Banlung. The reason for this was the short amount of time allocated for this field stay and the resulting need to manage several research processes in different locations in parallel. This organization of the research process led to an intense time schedule of research activities. Managing this would not have been possible while living in an indigenous village and being integrated into all of the daily life activities and having only occasional phone contact. Being based in Banlung, I would take the motorbike daily to visit the villages of the participants and other indigenous villages within a radius of two hours' drive, as outlined in Map 4. This map is purposely designed so that it does not reveal any realistic details

about the location of the villages in order to guaranty anonymity of the participants.



Map 4

In general, so as to guarantee an action research process driven by the participants, the whole setting had to be very flexible and developed as a series of path-dependent steps that made it possible to integrate the demands and suggestions of participants, as outlined earlier.

To give an idea of how a research day looked and how the research process progressed, I would like to give an example of a typical day.

Example day:

The research time schedule depended on the farmers' daily rhythm. Therefore, my translator and I took the motorbike at around 6 a.m. to arrive in the village to conduct workshops. These workshops we planned with the farmers at a previous meeting so that we could clarify a mutual aim, a plan and a date. In general, we visited the participants one day before or called the chosen facilitator in the villages again to confirm. This reassurance was needed as such conduct was a local behavioral code in order to give a mutual confirmation for the meeting to take place as agreed. One day before the workshops or meetings took place, my translator and I usually discussed together again the aim and the design of the workshop. This was to ensure a mutual understanding of the workshop concept, as we had to conduct it together as a team. In general, this mutual understanding of the aims

and concepts was key to succeeding in the conduction of the workshops. It was for this reason that the facilitation of such a workshop demanded the ability to moderate said workshop according to goals, with a high amount of sensitivity for complex dynamics. At the same time, it demanded flexibility and the openness to integrate farmers' suggestions and ideas. Therefore, the nature of the aim was beyond that of a concrete aim but rather related to an abstract aim. Here it is fitting to give examples of such abstract or underlying aims: one aim throughout the project was to encourage farmers to articulate their ideas in indigenous terms, while another more specific one was, for example, to encourage farmers to develop ideas for advertising their organic fertilizer. On the described day, we met with participants from three different villages in one village to discuss the advertisement movie. This entailed discussing the content, deciding on a script, and producing the movie. This workshop lasted around five hours, including several snack breaks. The workshop farmers came up with the idea that we could film how they spray the fertilizer over the rice fields. They also revealed that they might spray on that same day in the afternoon if the weather was good. At the end of this workshop we agreed on the next steps, in this case on meeting to discuss the first version of the movie. I was invited to lunch by a participating woman. While we were sitting in the kitchen for lunch, I discovered how they conserve the seeds which they save and this gave me occasion to start an informal conversation about the meaning of saving traditional seeds. I also received an invitation from an NGO employee to visit him to conduct an interview in the afternoon of the same day. This employee was working for a local NGO which specialized in transferring agricultural skills to indigenous farmers. Therefore, he seemed to have interesting insights into conducting workshops about eco-efficient methods. For those reasons, I asked him beforehand if it would be possible to conduct an interview. Knowing well that it is important to take the suggested date for an interview when it is offered, and that it is rude to reject, we agreed to meet in the afternoon. My translator and I took the motorbike back to Banlung to conduct the interview with the NGO employee and agreed to accompany him on a visit to some farmers' villages one week later as long as there was no heavy rain fall and the roads were passable. After the interview we returned by motorbike to the village of the farmer who wanted us to film her spraying the organic fertilizer for the advertisement movie.

Unfortunately, she was not in her field, but we met her afterwards at her house as she was preparing a natural fertilizer. This gave us occasion to conduct an informal conversation about traditional natural pesticides. As the farmer woman told us, she already applied the organic fertilizer to the whole field we visited together with her and another participant who was about to apply the organic fertilizer to his field. After shooting the movie, we had further informal conversations about the role of gender in making decisions to apply eco-efficient methods. While driving home to Banlung I received a call from another participant who invited me to attend a ceremony the same night. I took my hammock, left my equipment in the hotel and drove to the village, where I was invited to join the ceremony; I also stayed over in this village. While returning to Banlung the next day I met with my translator to reflect on the workshop and the interviews conducted the day before. As one can see from this example, some of the research occasions emerged during the day, while some were planned days ahead, such as the workshop and the field visit. On some days, e.g. when the rain was too heavy to leave Banlung, my translator and I used the time to reflect on the results, edit the movies, and discuss and organize the next potential steps. Therefore, the very active periods and more reflective periods were alternating according to the principle of Grounded Theory of simultaneous analysis and data collection.

5.7. Recording and Data collection

The data was recorded adapted to the different research methods as will be described in the following.

Interviews:

Most of the interviews were recorded by a field recorder. Only if the topic was considered as a sensitive topic, meaning a topic interviewee would feel not free to talk about if recorded, I took notes instead. Sensitive topics were for example sharing opinions about local extension staff or about cosmological concepts. In those cases, I took notes afterwards as I wanted to create a trustful atmosphere which feels for the interviewee like a natural conversation. Taking notes while the interview would have been interrupting. The notes I discussed afterwards with my translator to recognize gaps and

misunderstandings between me and my translator while the interview. For the interviews my translator and me considered as the most important, we transcribed together the recordings. One example of these transcriptions can be found in Appendix 4.

Group discussions:

Group discussions were also recorded by field recorder. The field recorder was also used as a tool to facilitate the discussion and ensure that all participants are equally given opportunity to share their opportunity: Using the field recorder like a microphone it was clear to all participants who has a turn to speak. Thereby everyone got the chance to hold the microphone as it was passed around one by one. Similar to the consideration about recording interviews also some group discussions were not recorded when I got the sense that it would disrupt openness of the participants. Therefore, the group discussion was always beginning with not recording and only if I had impression that it would be alright within the group dynamic to record, I asked the participants if it would be alright to record. If I had the impression that the participants of one certain group discussion felt not confident and it needed some effort to make them feel comfortable and share their opinion openly, I decided not to record. In those cases, I took notes. One example can be found in Appendix 4. After each of the group discussions I met with my translator and we collected our memories and discussed dynamics within the group to understand how the discussion emerged and which factors influenced the discussion. Those discussion were very important to understand how to facilitate encouraging inclusive discussions in the specific cultural context but also to understand themes which needs to be investigated more in deep. For the group discussions considered to be very crucial to generate my translator and me transcribed the recordings. One example can be found in Appendix 5.

Participative observation:

The participative observation was partly recorded in field notes but also in video recordings. Video recording some situations gave me actually opportunity to be invited to certain occasions. For example, I was invited to fieldwork within the traditional labor sharing system as I asked to record it via video. This made the labor sharing group proud

of their traditional way to cultivate rice and they invited me. If I would not have the camera with me, they would not have invited me for the reason that they did not perceive me as a potential help as a worker but more as interruptive as I was not trained in the cultivation method. One excerpt as an example of my field notes you can find here about a political conference.

This time a lady had a speech. He was the only
one and she was ^{CONTENTS} ^{DATE} ^{improving} ours.
Suddenly everyone started laughing.

At first I thought it might be that
she made a joke but asking
my translator why everyone is laughing,
she told me that the lady had use
a wrong word to greet the audience.
She told me: "She was greeting us
like one is greeting children."

I observed that the lady seemingly
felt uncomfortable by continuing her speech
finally she interrupted her own speech
in the and left the speech desk.

The reaction of the audience seemed
to make her feel embarrassed or
uncomfortable and may be not taken
MEMO... serious. When she finished
the audience was laughing while clapping.

Image 4: Own Collection, (2017), Field book excerpt

Video material of Participative video making:

The video material generated in the PV was a very important data recording. Nevertheless, those videos needed to be considered as exceptional data recordings as they were expressions of indigenous farmers what they want to express towards an audience of indigenous farmers. This means that for example the message movies needed to be considered in two dimensions: First there is the dimension of regarding the message as an opinion expressed and secondly the context of considering this opinion as an important message towards other indigenous farmers. Meaning that for example expressing the awareness about the health risk of applying chemicals showed firstly the sceptic standpoint of the individual farmer. But in the context of sharing this with other indigenous farmers it expresses that this individual farmer considers it as an important topic to raise in the specific socio-cultural context. Thirdly the way chosen to express this message is crucial as it shows how indigenous are framing and conceptualizing certain issues. This gives hints about cosmological concepts. The video material was translated and one example can be found in Appendix 6.

The PRA tools generated a data collection in various ways specific to the methods: Conducting the method of problem tree resulted in a problem tree graph, the timeline method in a timeline, rich picture method in several rich pictures etc.

Crucial to this study are beside the data recordings evoked by those methods the observations of the collaborative learning process respectively negotiation processes. Those I recorded in field notes. One example for those notes are given here:

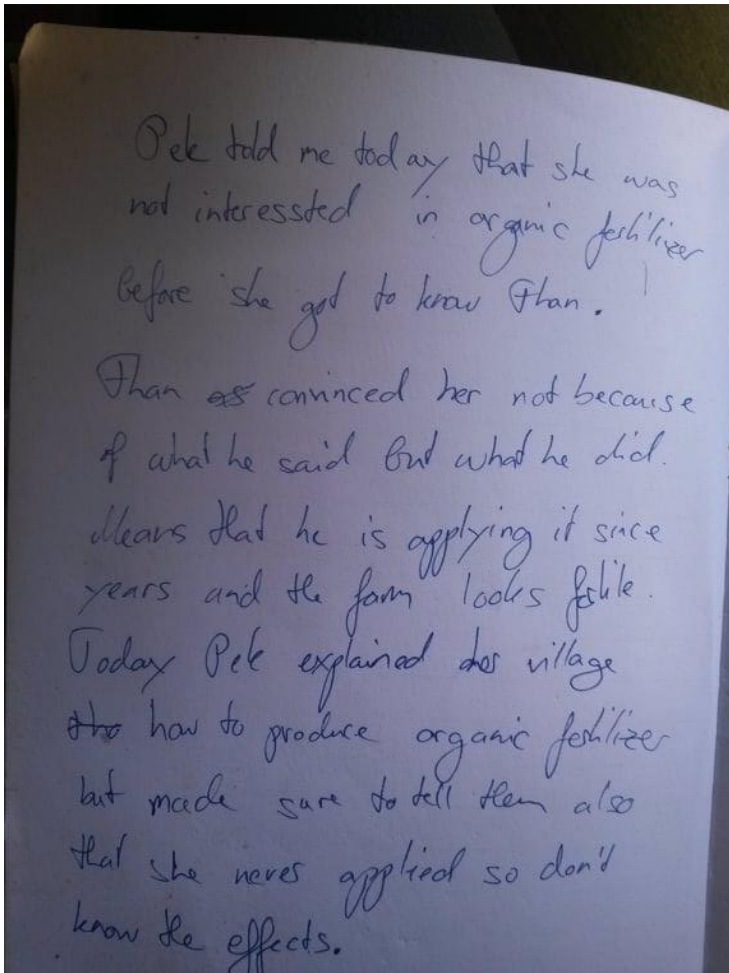


Image 5: Own Collection, (2017), Field book excerpt.

Furthermore, as we recorded on video and field recorder reflections about the learning processes, I chose to transcribe those additionally to gain comprehension of emic concepts applied to these reflections. Two examples can be found in Appendix 5 and 6.

5.8. Considerations about the operational analysis procedure

5.8.1. Applying principles of Grounded theory

Green and Thorogood (2009) claim that ‘Grounded theory’ is abused as a phrase increasingly by researchers. Therefore, I want to admit decisively to not conducting my analysis fully in terms of Grounded Theory. Rather I decided to borrow the theoretical framework of Grounded Theory. This decision was taken based on my previous experience applying Grounded Theory in my Bachelor thesis. My conclusion was that for the research question and the action research approach it is not advisable to apply text oriented open coding procedure used in Grounded Theory. There are several reasons for this: One reason is that this research is rather process oriented and therefore observation of the social learning and Participatory Video (PV) project are crucial to include in the analysis. Moreover, it would be appropriate to include not transcribe able material such as observations and merge different data sources such as videos, interview recordings and messages shared. All of these sources need to be treated in a different way and being relativized for their different characteristics. To give an illustration: A participative video cannot be treated like a semi-structured interview. ‘Video recordings are better regarded as sources for data than as data in themselves. From such records, data can be defined, analytically’ (Erickson, 2009: 158). In relation to this citation I would say that the participative videos need to be understood as a consciously created product aiming for giving a message. Therefore, underlying motivations and expectations need to be analyzed.

Another reason is the heavy amount of work needed to conduct the coding process as suggested according to Strauss and Corbin (1996) divided into three parts: In the open coding (1), the axial coding (2) and the selective coding (3). Properly conducted I would have transcribed my whole data. I decided that rather integrating a smaller amount of data it would be more appropriate to include my full data

set but not transcribing it as this is not feasible in the framework of a master thesis.

5.8.2. Interpretative Phenomenological Analysis

One method of analysis which seemed to be more suitable is the Interpretative Phenomenological Analysis (IPA) by Smith and Osborn (2004). IPA is appropriate as it is based on ideas of symbolic interactions (Denzin, 1995). However, IPA researchers realize that this chain of connection is complicated (Smith and Osborn, 2007): At first people struggle to express their thoughts and feelings. Secondly based on those expressions the researcher has to interpret people's mental and emotional (ibid.). In reference to the mentioned challenges it is crucial to bear this in mind while interpreting movies.

For these reasons I developed the following analysis design by borrowing the theoretical framework of Grounded theory and conducting the analysis of recordings and transcriptions with IPA.

The analysis started already while conducting field work. In the field I was engaged in an iterative, flexible process. Issues emerged as I had been engaged with the people and their context and I followed the leads where I needed to go in order to get to the root of (a full understanding of) the research question.

Therefore, one can say I approached the field with a child's mind: I tried to investigate the new area of research according to the key idea of Grounded theory by formulating explanations of observed phenomenon and to modify and discard ideas by experiencing resistance in the complexity of reality. In a steadily process of reshaping and modifying explanations I achieved theories which experienced no further resistance but being approved by the participants of my research project. These theories I outlined. In my second period of fieldwork I reappraised my theories with searching for confirmation or resistance in my data material according to the idea of Grounded theory to iteratively investigate if ideas are confirmed by emic assumptions expressed.

This analysis I decided to undertake with the ideas of IPA, which divides the operational procedure into 3 steps: (1) Looking for Themes; (2) Connecting the Themes; (3) Synthesizing different cases,

(1) Looking for Themes

In order to do so I elaborated concepts and categories by listening and reading the transcripts of the collected data material. With the key question: What are in the emic perspective of indigenous discouraging and encouraging reasons to (not) apply eco-efficient methods? Thereby I identified themes.

(2) Connecting the Themes

In a next step I linked those themes to each other and in order to elaborate the interlinkages in a systemic way. The aim of this procedure is to relate the elaborated categories and concepts to each other to understand the character of their linkage. These two steps explained in order to analyze the observations, explanations and narrations about the process of learning and decision making to apply eco-efficient fertilizer given by individual farmers to elaborate their argumentation structures. To sum up I analyzed on the one hand side argumentation structures and on the other hand side learning processes and investigate how they are correlated.

(3) Synthesizing different cases,

In a next phase I synthesized single argumentation structures of the individual farmers to a system of root causes. Regarding the non-application or the application as a symptom the underlying reasons which are interrelated in a whole “root system” of reasons are elaborated with permanently asking the question “why?”. This allowed me not only to understand the interrelation in a causal manner, but also to dive from the obvious into underlying concepts. In order to be able to draw conclusions about the importance of some reasons for indigenous small-scale farmers in Ratanakiri in general and to contextualize argumentations I applied here the data gained through additional interviews conducted.

As a final step to understand emic reasons for applying and not applying eco-efficient methods I elaborated a “Grounded theory” on a higher level of abstraction.

5.9. The eco-efficient method investigated

The eco-efficient practices chosen for the collaborative learning project were the use of effective microorganisms EM -fertilizer and natural pesticides, in particular, botanical insecticides as the model farmer perceived them as one of his most promising methods. System of rice intensification (SRI) has been taught as an eco-efficient method by many local extension actors, but with a low rate of adoption. Emic negotiation processes, if applied to this methodology, may provide interesting insights into barriers to SRI application.

5.9.1. EM-fertilizer

Effective microorganisms (EM) are a unique composition of diverse beneficiary groups of bacteria, yeasts and fungi used to activate the soil, promote plant growth, improve fertilizer response, and suppress harmful microbes. EM is used widely in environmental management for decomposition, see the appendix for a more in-depth description. (see appendix EM-fertilizer).

5.9.2. Natural pesticides/botanical insecticides

Biopesticides are pesticides based on microorganisms or natural products, such as naturally occurring fungi, bacteria and other microorganisms, or naturally occurring chemicals, such as plant extracts and pheromones. Generally, in comparison to synthetic pesticides, they have little impact on other non-targeted organisms, no harmful residues as they are biodegradable, as well as reduced negative effects on biodiversity. Botanical insecticides are a type of biopesticide, which are chemicals derived from plants (see appendix for more information regarding natural pesticides).

5.9.3. System of rice intensification (SRI)

The system of rice intensification (SRI) is an agro-ecological set of methods for an increasing productivity of rice cultivation systems. It includes significantly reducing the plant population, improving soil conditions and irrigation methods for root and plant development, as well as improving plant establishment methods (see attachment for a more detailed description of SRI). In Ratanakiri, extension actors only taught “semi-SRI”, a version of SRI adapted to the local situation. One crucial difference to the common practice of SRI is that indigenous farmers in Ratanakiri do not irrigate the rice but use rainfall instead.

6. Results

6.1. Comments

6.1.1. General considerations

Negotiations in decision making processes are complex and driven by contradictions. Through the research process I could observe emic discouraging and encouraging reasons applied to the adoption of eco-efficient methods. Even when some farmers decided not to apply eco-efficient methods, there were some who decided to. Therefore, it does not make sense to answer the research question by simply examining causality, but rather I have sought to understand which factors are encouraging and discouraging. This provides the opportunity to formulate suggestions for local extension actors working to encourage farmers in the application of eco-efficient methods. Considering discouraging factors is crucial to understanding why technologies are unfeasible and non-desirable and how learning processes can be modified. In this manner the research question “What are in the emic perspective of indigenous discouraging and encouraging reasons to (not) apply eco-efficient methods?” not only asks for reasons which are discouraging, but also those which are encouraging.

The design of this action research not only observed processes which happen in this area, but moreover initiated a collaborative learning process. The collaborative learning process facilitated within this action research differs in many aspects from a learning process facilitated by local extension actors. For instance, as the collaborative learning process was driven by the intrinsic motivation of farmers. Therefore, it is crucial to analyse these differences and to understand elements discouraging adoption.

In this investigation the word traditional is used according to the emic terminology. The differentiation between modern and traditional is emic and reflects differences. Is there a reflection about the own inherent history and cultural belonging in terms of the own being rooted in ideas and being confronted with new ideas? Is there a

judgment within this? This leads to a discourse which is, from my perspective connected to answer my research question.

However, it becomes evident that it is challenging to distinguish between 'culturally incorporated ideas' or in an emic reflection called 'traditional ideas' and 'adopted ideas' from 'Khmer culture'. I suggest that the distinction is rather fluid and opaque. The term traditional is not fixed but refined and reinterpreted over time. The knowledge identified as traditional is the one which is used by the current generation (which was eventually not in the past and will be changed in the future). To give one example for the emic distinction made: Cashew is perceived as an adopted idea while the upland rice cultivation in mixed culture is perceived as the traditional way of farming.

Nevertheless, to investigate the adoption processes of ideas it is important to explore how they change. As it is impossible to go back in time, I decided to rely on emic explanations rather than trying to conduct an artificial reconstruction by myself.

As elaborated in the chapter "Description of the local context" indigenous farmers in Ratanakiri can not be described as a single ethnic group. Rather one can distinct into seven to eight different ethnic groups. However, a majority belongs to the ethnic group Tom Poen. As outlined in chapter "First period: Explorative period" this was taken into account for the sampling of the studies participants. Therefore, most of the participants belong to the ethnic group Tom Poen. Despite many stakeholder such as researchers, local extension actors and indigenous farmers claim that except the language there are no significant differences within indigenous ethnic groups, I decided to focus in my study on the ethnic group Tom Poen. The reason for this focus is that I cannot claim that all indigenous ethnic groups in Ratanakiri are holding the same cosmological concepts because my study did not examine in depth differences in cosmological concepts of ethnic groups in Ratanakiri. Therefore, I can only claim that the results are evident concerning the focus group Tom Poen of this study. However, as some farmers of other indigenous ethnic groups in Ratanakiri participated as well in this study I would like to suggest that most likely that the results are evident for many indigenous ethnic groups in Ratanakiri.

6.1.2. Guidance for result chapter

In the following, I will outline my key findings for investigating the question: *What are in the emic perspective of indigenous in Ratanakiri discouraging and encouraging reasons to (not) apply eco-efficient methods?*

My study identified and contributes to three separate but related discourses. First, it sheds light on negotiation processes between different cosmological concepts in a transformation of culture. Second it will investigate socioeconomical, ecological and technical feasibility and desirability in the emic perception of indigenous farmers. Thirdly, it will contribute to the discourse on the relationship between teachers and students respectively indigenous farmers and local extension actors in the context of knowledge transfer about eco-efficient methods.

In the following, I will situate and analyse the results of my study in the context of these discourses. The first two chapters are concerned with the discourse on negotiation processes between different cosmological concepts. The first chapter will elaborate the influence of cosmological concepts on the decision-making processes of indigenous farmers in Ratanakiri if to apply eco-efficient methods. Understanding the significance of cosmological concepts presupposes a thorough understanding of the concepts. Therefore, an introduction to this cosmology will be the starting point for this chapter. This rather descriptive analysis of fundamental cosmological concepts of indigenous peoples in Ratanakiri provides the basis for the subsequent study of these concepts in their relation to the research question by exploring the emic concepts of soil fertility. Most importantly, the decision-making process of indigenous peoples in Ratanakiri on whether or not to apply eco-efficient methods has to be considered as a negotiation process between different cosmological concepts. Thus, this chapter will investigate the various parallel existing explanatory models of soil fertility belonging to the traditional cosmology.

The second chapter will focus on pest prevention methods, which can be considered as important as soil fertility for the adoption of eco-efficient methods. After providing a descriptive analysis of the two areas in which eco-efficient methods are applied in this study (namely soil fertility and pest prevention) from the emic perspective, I will turn

to the negotiation processes triggered by the cultural transformation processes indigenous farmers are experiencing. This study shows that these cultural transformations assert a decisive influence on the adoption and application of agricultural practices: As I will explain later on in this chapter the adoption of new agricultural systems induces a change in cosmological concepts, which in turn influences the decision-making processes on the types of agricultural practices that will be applied. This causal connection necessitates an exploration of these cultural transformation processes, which entails the identification of the main forces driving these processes. Building upon this analysis, I will investigate how the cultural transformation processes as well as the adoption of new cosmological concepts are reflected in the adoption of new agricultural systems.

The third chapter leads me to the second discourse identified above: the socio-economical, ecological and technical feasibility and desirability of eco-efficient methods. In this context it is important to, first, describe the traditional cropping system and its role from the emic perspective. Building upon this gained comprehension about the traditional system, socio-economic barriers to the application of eco-efficient methods will be outlined. As this study aims to not only understand existing barriers to but also encouraging reasons for the adoption of eco-efficient methods, the subsequent section identifies and analyses various such encouraging socio-economic reasons from the emic perspective. Based on the prior finding that traditional and modern agricultural systems have to be considered different cosmological spheres, encouraging and discouraging reason for the application of eco-efficient methods in the modern system will be analysed separately. Next, I will examine the emic reasons (not) to apply eco-efficient methods by concentrating on ecological considerations by indigenous farmers. In other words, I will evaluate the subjective desirability to apply eco-efficient methods in ecological terms.

Finally, I will turn to the third dimension identified in this study as being crucial to the decision making of indigenous farmers in Ratanakiri whether or not to apply eco-efficient methods: the relationship between teachers and students. I identify distrust in teachers and new methods, lack of mutual understanding and foreign

teaching methods for indigenous farmers as main obstacles. In a concluding section, I develop a theory explaining core discouraging and encouraging reasons for the application of eco-efficient methods by indigenous farmers by formulating a Grounded theory.

6.2. Negotiation processes between different cosmological concepts in transformation of culture

What follows is an investigation into the influence of the cosmological concepts of indigenous small-scale farmers on decisions to apply eco-efficient methods.

6.2.1. Traditional concept of being in relationship with spirits

Being in relationship with spirits and mutual responsibility

Key to the cosmological concept of indigenous in Ratanakiri respectively indigenous belonging within the ethnic group of Tom Poen is the idea of being in a relationship with spirits. These spirits are non-human beings which are omni-present while not visible. However, they can become visible in different forms such as in the appearance of a human. This means they do not have a fixed appearance and are not locatable for humans. Nevertheless, they share their living areas with humans, meaning they have different spaces of living such as trees or the main house of the village, the sky or a plant. Furthermore, they belong to different concrete areas of the perceptible world, for example one specific crop or the village. According to traditional belief every crop belongs to a spirit. This relationship between a human being and a spirit is characterized by a mutual responsibility for each other. While the human being is responsible to protect the living space of spirits such as the forest and to provide food,

the spirits are responsible for the health of plants and humans. Different spirits are connected to different areas of humans' every-day life and therefore have different responsibilities. For example, there is the spirit called "Angel" living in the sky responsible for the well-being of rice plants so it will not be affected by any phenomenon which could harm it. For example, it won't get attacked by pests and it will rain the right amount. Consequently, the farmer will have a healthy plant and therefore a good harvest.

"(...) growing the rice, we have to inform them and tell them and the main reason of doing this because we want them to advice, us or to take care of our rice".

One can say that spirits are seen as enabled to control natural phenomena or one can say that phenomena that are regarded as natural science in the western scientific construct are regarded as a symptom of spirits not taking care within the cosmology of Tom Poen.

"(...) because we believe that spirit has much power over this and we believe that the spirit will make the rains come regularly because the rice cannot live without water, so we believe that when the spirit is not angry, the rain will come regularly, but if the spirit angry with us it will not rain again so our rice will die".

Consequently, Tom Poen people need to establish and maintain good relationships with spirits as their health and the health of the plants are dependent on the spirit's willing to take care of them. This relationship is key and could be described as an ethical demand in the sense that there are expectations of care for one another. There also exist fixed expectations formulated in behavioural codes such as the duty to provide food for spirits in regularly organized ceremonies.

Ethical demand by the spirits to ask for permission to cultivate land
There are negotiation processes through which farmers need to show their respect towards spirits. They communicate either through a shaman as an intermediary between human beings and spirits, or through signs. One example is that farmers need to ask for permission before they cut down trees or before cultivating a piece of land "We have to go to the forest and ask permission from the spirit: can we cut this forest to make a farm or we cannot?".

There are defined actions which farmers need to conduct in order to ask for permissions. Spirits will answer the request in different ways such as through dreams, illness, and emerging conflicts or through clearly defined signs. These signs are like indications which need to be interpreted by the receiver. There are some codes to interpret these signs, for instance, in order to ask permission for using a piece of land, a farmer will grow a certain plant on the land he wants to cultivate. If this plant is growing well he is allowed, but if it does not he has a clear sign indicating that he is not allowed starting cultivating.

Another indigenous farmer gives this example:

“We have to go to the forest and ask the permission from the spirit: can we cut this forest to make a farm or can we not? (...) so we have to go to the forest and we stay there for one night for the dreaming for the asking for the permission from the spirit. So at night we will dream and the spirit in the forest will tell us whether we can do it or not.”

Farmers need to pay careful attention to these signs in order to pay respect to the spirits. If a Tom Poen fails to pay respect and fulfil the ethical demands of spirits, the spirits will become angry and react by not caring about the health of human beings or even making them sick

“In total we do the sacrifice five times a year if we don't do this we believe that the spirits will get angry and making us to have poverty”.

One of the participants in the collaborative learning project was not allowed by spirits to cultivate his land. He knew about this as his wife and daughter became sick after they married and moved there to cultivate the land. Therefore, they decided to move back to his wife's family house and were unable to cultivate their own land.

Living in relationship with spirits

All spheres of life are traditionally affected by spirits. The traditional cropping system as well as interactions with the jungle as hunters and gatherers incorporates this cosmology and is an essential element in the community and its social institutions. Underlying concepts which explain these phenomena are reproduced and legitimized through social structures and these are based on the belief in spirits. Examples are the: health concept, community, distribution principals, land right

system, slash and burn, intercropping and the council of elders. As such, agricultural activities seem to be based in this cosmology.

Concerns about provoking the anger of spirits

Believing in spirits also seems to be connected to being scared of doing something which provokes the anger of spirits. I often met uncertainty on the side of Tom Poen people about a possible reaction from spirits. For example, a man who was considered by the Tom Poen living in a specific geographical region as a specialist in understanding the spirits told me the following anecdote: he prepared a mixture of frogs and herbs to fight pests. While he was preparing, he feared provoking the anger of spirits. He was unsure, if they agreed with him mixing the ingredients. He explained that mixing different ingredients can provoke anger in general. There are some rules but he articulated that if mixtures might provoke anger remains uncertain. In order to be cautious and not risk turning the spirits angry, it seemed preventive to be acting according to experienced and heritage practices. When I asked if the application of fertilizer or pesticides could make spirits angry, farmers repeatedly disagreed. However, while we conducted the advertisement movie we explored concerns farmers might have towards applying organic fertilizer. One concern they formulated was that organic fertilizers may destroy the soil and harm plants. This mirrors scepticism towards new methods.



Conclusive summary

Tom Poen are dependent on good relationships with spirits in the cosmology, which is emically referred to as traditional. This is due to a mutual responsibility of taking care. When spirits take care of the farmers plants they will earn a good harvest. Spirits have power over farmers as they can threaten them if farmers behave in a way that the spirits dislike. While traditional practices have shown to be accepted by spirits, new agricultural practices lead to an uncertainty about the reactions of spirits. This might support what is perceived as scepticism towards new innovations.



In the next section I investigate the cosmology of specific agricultural domains. The focus will be on the domains which seem to me relevant for the eco-efficient methods investigated in this research: the concept of soil fertility and pests.

6.2.2. Concept of soil fertility in the traditional cosmology

Being in relation with spirits is reproducing slash and burn and shifting cultivation



Image 6: Own Collection, (2017), Slash and burn field.

How and how long the land is used is decided by the spirits. If spirits decide that the villagers have to move, there will emerge conflicts within the community and members will become sick. So, by receiving these signs and asking for advice from the council of elders the community will know that they have to move. As an underlying assumption it was explained by Tom Poen that spirits turn angry because they do not like it when humans do not move. The reason

articulated is that the land needs to rest and spirits feel disturbed. The same will happen to a single farmer who is growing his rice more than three or five years on the same field. He receives a sign by the spirits when his rice will turn red. Then he will know that it is time to grow rice on another field and leave the land for a rest. This I interpret as a driving force for reproducing slash and burn and shifting cultivation system. Farmers explained to me that as it is no longer possible to leave land fallow, due to limitation of land, spirits have come to change their minds and do not become angry if farmers are unable to move.

3.2.2.2. Ecological explanation models for the need to shift fields

This does not mean that there are no other emic concepts to explain the need to shift fields. There are emic terms for the status of soil quality. This status of the soil is connected to how well plants can grow on it. In the indigenous language of the Tom Poen there are specific terms for the soil after the first year of having burned down the forest, the soil after the second year and for the soil after the third year. Furthermore, different rice varieties are grown and adapted to the status of the soil. The loss of soil quality is explained by erosion due to heavy rainfall and the geographical conditions of the upland fields on steep hills.

3.2.2.3. Traditional methods to improve soil fertility

Pumpkin is grown on the ashes of collected and burned weeds and branches. From an agronomic perspective pumpkin needs more nitrogen which ashes can help provide. Therefore, one can assume that it might be a strategy based on the experience that pumpkins grow better on ashes. When asking for an explanation as to why they cultivate pumpkins on ashes farmers explained that they experienced this as a better way to gain a high yield. Therefore, it seems to be based on heritage knowledge and experience rather than on an actual knowledge of soil fertility. Intercropping with beans is also used in the indigenous cropping systems. Those are leguminous and are providing in an ecology perspective nitrogen. Therefore, one can conclude that methods which could be called eco-efficient and which support soil

fertility are inherently integrated in the indigenous intercropping systems. Furthermore, it emerged that there are three main methods to improve the soil fertility: mixed culture, slash and burn and leaving soil to rest. In all these strategies the idea that one cannot cultivate a crop for several years is present.

3.2.2.4. Organic fertilizer as a new idea

These strategies mainly incorporate changing the cultivation system by leaving the land fallow. This goes hand in hand with believing that spirits feel bothered if they cultivate one crop too long on the same field. They call the land on which they have just practiced slash and burn “new soil”, thus indicating an appreciation of soil rejuvenation by leaving it on its own. Apart from the use of chicken manure in home gardens, I did not come across the use of organic fertilizers as advocated by the extension service being part of the indigenous cultivation system. Chicken manure is not generally applied in the traditional rice intercropping systems. This indicates that the idea of adding nutrients by using organic fertilizer is a rather new idea for Tom Poen and does not feature in their traditional intercropping system. Indeed, when I asked farmers who had not received any education about fertilizers if they knew how to improve soil fertility they could not tell me a method. Instead they considered it as a new idea.

3.2.2.5. The idea of organic fertilizer is challenging a traditional conviction

The idea of feeding the soil with added materials instead of leaving the soil to rest is a new idea. This new idea challenges the traditional conviction. It seems that introducing a strategy of improving soil fertility does not lead to solving the necessity to shift fields and giving the soil a rest to renew itself, as the spirits do not want to be bothered for too long. When I discussed with farmers how it might be possible to maintain soil fertility they considered it as impossible, even through the application of organic fertilizer. Only the idea of integrating crop rotation seemed to interest them. However, they felt the need to conduct trials before believing it was possible. An indigenous farmer explained the idea of organic fertilizer as follows: “The soil is like a human body. Therefore, one needs to take care and feed the soil so it can be healthy”. One main idea for maintaining relationships with

spirits is feeding them with sacrifices. Maybe one can observe here reframing of a new idea in an emic comprehensive traditional concept.

6.2.3. Reflection about parallel existing explanation models

Several parallel concepts to explain the phenomenon of lost soil fertility can be observed. These concepts could be intertwined or standing beside each other. Whereas spirits are enabled and empowered to care for the plant health and showing that they want farmers to conduct regular shifts of fields after certain time periods, there are also existing explanation models of soil fertility loss and methods which enables humans to care for their plants by themselves. Culture is not based on a coherent logic, but complex parallel existing and antithetical explanation models. Rather than seeking for clear logical structures, I aim to search for tensions and contradictions as well as overlaps which constitute negotiation processes. How experiences and observations are transferred and incorporated in cosmologies such as into mythologies is another question and can give some information as to how ideas exist in different shapes and levels of conscious reflection. In reference to this idea of constituting culture, Tom Poen ‘traditionally’ regard themselves as being dependent on spirits to receive a rich harvest, but at the same time they are also in charge and enabled to care for their plants. Both concepts of responsibility are intertwined. Likewise, belief in spirits is intertwined with shift and burn cultivation. Furthermore, nature and spirits are articulated as inseparable: several times people explained to me that each crop, each tree is connected to a spirit. For this reason, one could claim that dividing into spirits and ecology is ethnocentric.

3.2.3.1. Priority for maintaining a good relationship with spirits

Asking the farmers if it is more important to apply good farming practices or if the spirits are more powerful, they answered: to conduct ceremonies in order to maintain a good relationship with spirits is most important. If they do not practice ceremonies they will risk becoming

sick and there will not be a good harvest for sure. Clearly there is clear priority setting. This only applies for the traditional intercropping system.

3.2.3.2. Ceremonies are maintaining relationships with spirits and within a community



Image 7: Own Collection, (2017), Sacrifice ceremony.

Ceremonies do much more than maintain relationships with spirits, they also maintain social relationships within the community. Participating in ceremonies is a social act. For example, I participated in a healing ceremony which was described as being similar to the ceremony for the spirit of the rice ‘Angel’. In this ceremony, a young bull as was slaughtered as a sacrifice to the ‘Angel’. All participants were involved in the process of the slaughtering, preparing the meal and finally sharing the bull in a communal meal. The principle of sharing is inherent in this ceremony. Being present as a villager at ceremonies which one was invited to also seemed to be crucial. In another shaman healing ceremony nearly the whole village as well as relatives from others participated, playing cards and consuming rice

wine. Rice wine has several meanings for maintaining relationships. For example, when we arrived in one village and a ceremony was conducted we had to drink from each rice wine bottle otherwise we would have brought misfortune over the person offering it to us. When consuming the wine in a ceremony, the wine is shared with the spirits. Family elders also communicate to spirits by singing and praying while consuming the rice wine. The food is shared with spirits in the same way. One farmer explained that ceremonies need to be done also because they are expected by society. To conduct ceremonies or participate in ceremonies therefore becomes a social duty.

6.2.4. Concept of pests in Tom Poen cosmology

3.2.4.1. Shared responsibility within human and spirits



Image 8: Own Collection, (2017), natural pesticide production.

During my research it became evident that pest prevention methods are based on beliefs in spirits and therefore agricultural practices are intertwined with being in relation with spirits.

Pests will attack plants if the responsible spirit does not take care of these plants. So, farmers seem to assume that pests are a symptom of the spirits not taking care.

Another way to prevent bad harvests caused by spirit's anger is to have different crops at the same time. Indigenous farmers explained to me that the reason they cultivate in intercropping systems is that every crop is connected to a different spirit. Therefore, intercropping leads to a higher resilience: if one spirit becomes angry resulting in a sick crop and poor harvest, the other crops will still give harvest.

I observed that farmers have rich knowledge in recognizing pests. They also have traditional methods to fight and prevent pests. When we discussed the pests which farmers recorded, some explained traditional prevention methods such as using extracts of bitter leaves, they apply in a mixture to prevent pests. So, while spirits are responsible for plant health, human activities also play a role in preventing pests.

Reflection about the coexistence of two explanation models for sickness
We find similar concepts here as in the domain of human health care. This idea arose because of the emic way chosen by an organic farmer while he was teaching other Tom Poen farmers. He explained the necessity to care for the soil and prevent pests by comparing them to a human body such as to a child one has to care about and feed. While in the traditional understanding human sickness is primarily caused by spirits, humans can also be in charge of taking care of human health healing. Medicines prepared from leaves and roots of wild plants are used within traditional medicinal practice.

Here one can find the coexistence of two different health concepts. An explanation I received as I asked about the coexistence of these two areas of responsibilities was that there are at least two kinds of sickness. One when sickness is caused by angry spirits and there is a need to solve this by improving the relationship with said spirits. This can be in the form of ceremonies in which a sacrifice is given in response to their request. Furthermore, sickness can also be ghosts or the souls of ancestors which are either hungry or have other conflicts. These conflicts become obvious through the obsessions of alive relatives.

The other “kind” of sickness is caused for example by mosquitoes. It was explained that this is a new idea which the Tom Poen adopted in connection to the introduction of Khmer health care systems. Malaria for example is a new explanation model for Tom Poen, it is not caused by spirits and can therefore be healed by Khmer doctors. Some Tom Poen disclosed that often cases of illnesses which cannot not be diagnosed, occurred by Khmer doctors occur. In these cases, where after many attempts to heal using the advice of Khmer doctors, the Tom Poen would revert to traditional health care providers, i.e. the fortune teller or shaman, for help. The explanation was that failure of the Khmer health care system to diagnose and treat a condition indicates a illness caused by spirits. Similar to this explanation regarding human health, is a division between two main prevention methods concerning plant health. Pests and diseases caused by spirits need to be prevented and solved by building relationship with spirits. The other way to prevent pests is by humans taking action, for instance, using traditional prevention methods.

When I asked what is more important, the relationship with spirits or the agricultural methods applied, many farmers replied that the priority is to maintain a good relationship with spirits in order to have healthy plants. Nevertheless, similar to the adoption of new ideas concerning human health care, I observed that when farmers explain pest outbreaks using ecological concepts such as rain, they begin to put more effort into learning new techniques. The reason could be that they perceive themselves more in charge or enabled to treat plants.

Connection between soil fertility and health of plant as a new concept
“Bad soil” leads to low harvests of rice. This was a connection I often got told about by farmers. This is also the reason why they stop cultivating rice on a certain piece of land after cultivating it for some years. In relation to this commonly held belief it proved challenging to distinguish between ‘culturally incorporated ideas’ or in an emic reflection called ‘traditional ideas’ and ‘adopted ideas’ from ‘Khmer culture’. I suggest that the distinction is rather fluid and opaque. Nevertheless, to investigate the adoption processes of ideas it is important to investigate the change in ideas. As it is impossible to go back in time I decided to rely on the emic explanation rather than

trying to conduct an artificially reconstruction by myself. One symptom of sickness or a bad harvest used by farmers is rice turning red. Farmers in my collaborative learning process investigated this and searched for a new explanation. One female farmer asked the following to the organic farmer:

“I just want to ask you, I have worked on my farm land just for three years but in year 3 my rice growing not good, its leaves look like red colour, why it is like that?”

The organic farmer answered and referred to disease as a new idea: “(…) Normally when we see our rice like this we always say the spirit makes our rice to get sick but actually it is not, it has disease”.

In the emic perception the following is a traditional explanation model: Rice turning red means that the spirit did not take sufficient care of the rice “(…) sometimes when rice does not give more yields we think that an angel or spirit has taken it away, but in fact the pests destroy it or the soil fertility is not good. When we learned about the new technique and apply I we know that: We can’t grow rice well when it has more rain or no rain that cause insects to destroy it”.

In this citation the farmer claims that low yields caused by decreasing soil fertility is a new concept to the Tom Poen. Consequently, there seems a missing connection between soil fertility and the health of plants.

6.2.5. Main ideas motivating a cultural transformation

The transformation process is shaped by the emergence of new needs and forces. These are heavily interrelated with the changes due to Khmer immigration and Vietnamese investments. Vietnamese investments are mainly timber, rubber plantations and cashew plantations. These changes have induced significant deforestation and the introduction of new technologies.

Deforestation leads to the decrease and outright disappearance of main food sources for Tom Poen.

Tom Poen previously sustained their livelihood, beside the traditional shift and burn cultivation, by being hunter and gatherers in nearby forests. Consequently, the necessity to find new sources of food has

emerged. At the same time land sales, new land laws and land grabbing by foreign investors and Khmer people have resulted in land scarcity. This, in turn, is leading to many indigenous people staying on the same land which is forcing farmers to give up the traditional shift and burn system. As explained above this leads to decreasing soil fertility. By the third year the soil fertility is not sufficient to cultivate rice anymore. As a result, farmers are increasingly giving up rice growing as they are no longer able to prepare new fields.

The need to find new strategies as a means of survival

Due to the changes described above the Tom Poen are no longer able to sustain themselves using subsistence agriculture thus the need to find other food sources has arisen. One possibility is to integrate into other distribution systems such as the market system offered by Khmer immigrants. Two ways of integration can be observed. One is to integrate into the market system by, for example engaging in business through the sale of agricultural products, offering labour for plantations, working as tourist guides, or NGOs. This way of integration means adopting the distribution principles of a capital system and entering into the monetary system. Another way is to not adopt this principle, but instead to practice the exchange of goods such as cows or land against motorbikes or mobile phones.

Emergence of new desires and needs for money and technological facilities



Image 9: Own Collection, (2017), Often cows had been exchanged against motorbikes.

One can observe a possible reason for the emergence of new desires. The motorbike becomes a tool to be able to conduct business as the products have to be brought to and from the market which can be hours from the villages. Also, farm lands are often relatively far from home villages, which make the motorbike a convenient all-day life tool. The same applies to a mobile phone which becomes a tool for accessing possible work opportunities in a market system, such as in the area of tourism, coordinate with NGOs activities or become involved in politics. Integration into market systems either through agricultural practices or other labour becomes a desirable strategy as money becomes an important medium to access facilities and alternative food sources and facilities such as medical health care provided by Khmer or products such as beer and medicines.

Asking indigenous farmers in a group discussion, what they aim for by conducting agriculture they simply said: “Money!” So, money itself becomes desirable. Money was articulated to be necessary for accessing comfort by investing in the building of a bigger and more comfortable house, buying a motorbike or car, sending children to school, paying for medical treatment and purchasing meat. Asking what people need to be happy they told me: “Money!” So, money seems to become a mean for happiness.

6.2.6. Cultural transformation process through the adoption of different cropping systems



Image 10: Own Collection, (2017), Harvested cashew nuts.

Adoption means more than just adopting a new cropping system, it also means to adopt ideas which are connected to entering a different sphere of cosmological concepts such as entering the monetary system. I will elaborate on this in the following section.

Emic reflection about different spheres of cosmologies

Tom Poen people appears to reflect a different belief system specific to their ethnic group and other cultures such as Khmer and “Barangs” (the Khmer word for foreigner). They create a “we and the other” by the distinction of “believing in spirits” or “not believing in spirits”. They argue that if a human has no belief in spirits, spirits will have no power over them. Therefore, believers have a relationship with spirits,

are dependent on their care and threatened by their anger. ‘Others’, being non-believers, are unaffected.

For example, if a “Tom Poen” is cutting down a tree without asking for permission he will anger the spirits and as a consequence get sick. However, if a Vietnamese person for example, who is assumed by Tom Poen not to believe in spirits, cuts down the forest he will not be affected. But the Tom Poen community who is responsible to protect this specific forest will be affected by the anger of the spirit. One could suggest that Tom Poen assume in their emic reflection differences in the experience of everyday life due to cosmologies. This difference could be described as being in relation with spirits or not. Nevertheless, it does not seem limited to this. Moreover, there seems to be different spheres of action which are either affected by spirits or not.

It is not just the ‘believer vs. the non-believer’ dynamic that affects spirits reaction to behaviour or affects outcomes as a result of spirits. Different crops are linked to different spirits, as mentioned earlier, yet some crops do not have a relationship with spirits at all. These are the non-traditional crops that have been introduced to the area. Spirits do not govern these cropping systems. As these cropping systems are not in the spheres of spirit farmers do not have to follow the traditional behavioural codes for these crops and are free to adopt eco-efficient methods.

For example, the traditional intercropping system is a sphere of spirits, but the introduced cropping systems by “Khmer” and “Barang” such as cashew plantations are not considered to be a sphere of spirits. As mentioned before Tom Poen have to be cautious when they mix different ingredients, for example to produce food or natural pesticides because it could be disliked by spirits and cause heavy sickness. When Tom Poen mix ingredients together with other people, who are considered not to believe in spirits there won’t be any danger for Tom Poen either. One can conclude that conducting activities together with non-believers or standing in connection to them creates a different state of being in relation with spirits in that moment. At least three different interrelated states of being in relationships with spirits can be observed. These are shaped by the way activities are connected to non-believers:

1. The traditional sphere such as traditional intercropping system, this is when Tom Poen are in relation with spirits.
2. In the interaction with “non-believers”, Tom Poen are not threatened by the anger of spirits.
3. Cropping systems which are introduced by “non-believers”, such as cashew and cassava, are not affected by spirits as they are not in a relationship with them

Emic association of cropping systems as socio-economic and cultural complexes

The emic reflections about the co-existence of different cosmological concepts and their implications for cropping systems are influencing perceptions and activities in different cropping systems. In view of this, it becomes obvious that to understand the question why farmers do not apply eco-efficient methods, there is a need to regard cropping systems not just as practices, but as socio-economic and cultural complexes. These socio-economic and cultural complexes incorporate values, distribution principles and cosmological concepts. They constitute social relationships and enable access to different goods which are also connected to ascriptions. To understand this, we need to understand the emic meanings of these systems.

6.2.7. Summary: The influence of traditional cosmology on the implementation of eco-efficient methods

Traditional intercropping system and vegetable home gardens are the main domain which local extension actors try to improve using and promoting eco-efficient methods. These are also the production systems which are governed by the spiritual domain. One eco-efficient method encouraged to improve traditional rice intercropping is the previously explained SRI (system of rice intensification) involves the application of natural fertilizer and natural pesticides. When it comes to home gardens, the use of compost and natural fertilizers as well as natural pesticide is encouraged. The same applies to fruit tree areas.

Now local extension actors claim that farmers often decide not to apply these taught eco-efficient methods.

Returning to the initial question “Why farmers do not adopt eco-efficient methods?”, it seems that there is a need to develop an understanding by regarding cropping systems as associated to different cosmologies. As such, there is a need to distinguish between different cropping systems.

In view of the traditional concepts about soil fertility and pests, it becomes obvious that the idea to improve soil with organic fertilizer challenges traditional concepts as a new idea.

For many farmers it does not seem feasible to improve soil fertility with the suggested methods. The concept that mixtures of different ingredients can enhance the fertility of soil is new and not coherent with the traditional belief in the need to shift fields, leaving it to rest and “renew”. Therefore, there might be more resistance in terms of scepticism and hesitation towards the application of organic fertilizer. Acting in relationship with spirits leads as previously elaborated to uncertainty about which activities provoke anger in spirits such as mixing different ingredients. Traditionally conducted practices proved not provoke the anger of spirits, discouraging experiments with new methods.

As elaborated in the reflections about the concept of soil fertility, from an emic point of view ceremonies are more important than human activities in maintaining plant health and achieving good harvests. If they do not practice ceremonies they will threaten themselves, become sick and certainly not have a good harvest. Time is considered as a limited resource. To the indigenous farmers it is a question of priority setting. They can either invest time and money in fostering a good relationship with the spirits, or alternatively, in methods such as organic fertilizer or pesticides. So, if farmers give priority to ceremonies they don't feel eco-efficient methods are sufficiently efficient to invest time in. In fact, when I asked farmers directly why they did not apply eco-efficient methods, they often answered: “Because I am too busy with other things.” These were farmers who had learned about organic fertilizer. Asking which other activities, they need to conduct, they explained that the main part is community

activities, mainly ceremonies, followed by farming and household keeping. As outlined above ceremonies are about much more than maintaining the relationship with spirits; they also maintain–social relationships within the community. Therefore, conducting ceremonies has a more holistic necessity than applying organic fertilizer and enhances the priority setting.

Farmers who apply organic fertilizers and natural pesticides or SRI outbreaks of pests and diseases and of decreasing soil fertility as related to natural phenomenon, rather than the actions of spirits. Similar to the transformation process of human health concepts outlined above, some farmers have come to view that there are plant sicknesses which are caused by natural phenomenon and can therefore be treated by humans. Noticeable by reframing the idea of organic fertilizer in an emic comprehensive concept the organic farmer compared the need to maintain soil fertility with a child that needs to be taken care of.

When a human is perceived as strongly able and responsible for the soil fertility or plants, farmers seem to be encouraged to find new methods. This means to adopt the idea that farmers can increase yield and are responsible for the success of their agriculture with their way to practice agriculture. This idea encourages them to learn eco-efficient methods. Likewise, the concept of humans' ability to prevent diseases as this idea is not merely new. Rather one could describe it as a co-existing of concepts and a shared responsibility between humans and spirits. Nevertheless, from a traditional point of view spirits are most powerful. Therefore, I would describe this process not as an adoption of a totally new idea, but rather as a gradual shift in the perception of the degree of the responsibility ascribed to human beings. Given this, I would argue, that when farmers are able to explain sickness or decreased soil fertility in a way that assumes their associated responsibility they tend to regard themselves as more enabled to also improve soil fertility.

One participant who conducted interviews with a successful farmer and learnt about eco-efficient methods decided to apply organic fertilizer on her whole fields. Later I asked her if she could explain why it was improving the soils quality. She explained to me that the soil was becoming healthier. She described it as like feeding a human

to become healthy. It was apparent through our conversation that she could not explain to me in ecological terms what happens within the soil when fed. Therefore, rather than understanding ecological processes it is necessary and crucial to adopt an explanation model within which human are responsible and in control and which makes sense in the cosmology of Tom Poen.

Regarding soil as a human like body seems to make sense within the cosmology of Tom Poen. My assumption is that the strong relationship component as well as taking care by feeding a child or giving medicines to someone who is ill is similar to the idea of a ceremony in which spirits of soil and rice are fed to maintain good relationships.

Three concepts to change the perception of indigenous farmers and thus enable them to improve their agricultural results are:

Firstly, questioning the high responsibility of spirits by adopting explanations within which humans receive a higher responsibility for the success of agriculture. A reasonable emic explanation model is being the caretaker for a soil which is regarded as a human like body. Under this explanation model a human for example is enabled to feed the soil or treat a plant.

Secondly, a central concept which encourages taking action for soil fertility is the connection between a healthy plant and good soil quality. As mentioned above, this connection is traditionally expressed as an indicator of the need to shift fields.

Thirdly, the adoption of the idea that shift and burn and leaving soil to renew, itself is not the only way to regenerate soil.

Noticeably when farmers conducted their interviews with the successful organic farmers they most notably asked “why?” questions. This means that they were interested in finding explanations for observations. The second most commonly asked questions were “how?”. Reflecting their interest in seeking different methods.

All the questions asked by farmers interviewing successful farmers were driven by problems which threaten harvests (such as pests). Also, when asking farmers to film problems on their fields the images they

mainly showed were pests. Farmers told me that even if they currently do not see a value or need to apply organic fertilizer, they will do so in the future when they experience a problem with their soil. (I will investigate this idea of the soil as fertile enough in a later chapter).

I would argue that interest in eco-efficient methods is mainly driven by the need for alternative strategies when traditional ones and explanation models do not offer viable solutions. Furthermore, possessing the idea that there are different explanations and strategies is evidently a vital driving force for learning. In an interview with a Tom Poen who considered to be very knowledgeable about spirits I was told that he would like to learn about organic fertilizer. He articulated the need to know new ways to improve the soil due to decreasing land availability. Evidently one factor encouraging greater openness to new ideas is that old strategies such as shift and burn are regarded as obsolete. Interestingly, how one gets in contact with a new idea is critical when deciding if it might be of interest. I would argue that for the indigenous farmers I worked with, the processes of is key. Likewise, experiencing rather than only being told about it is essential. I will investigate this element in detail in the chapter called “experience and learning processes”.

As summarized in Figure 7 the attitude towards human agency and if an individual farmer perceives an eco-efficient method as logical within cosmological terms encourages or discourages adoption.

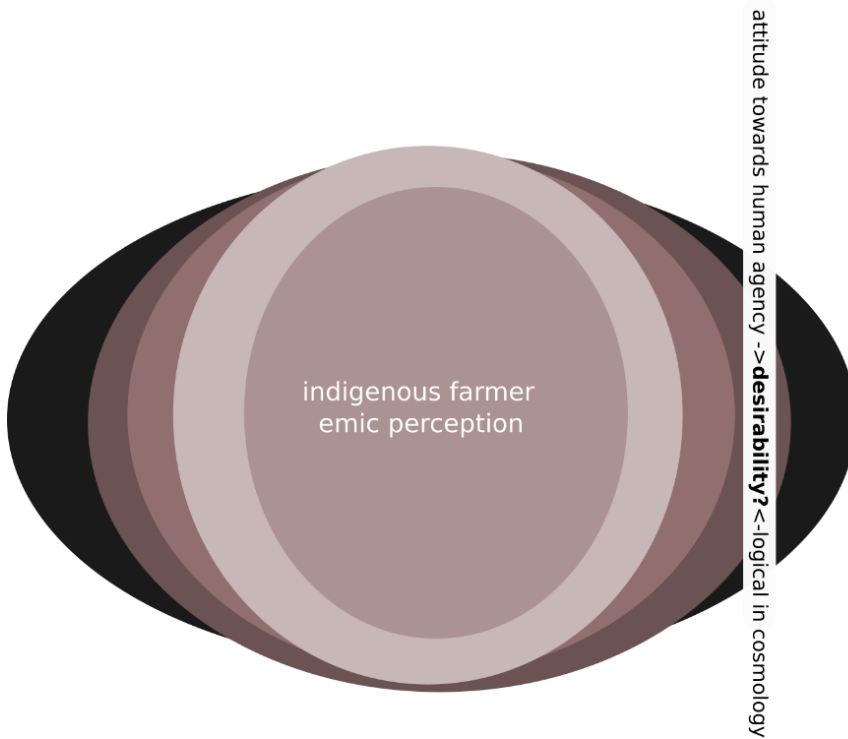


Figure 7: Own Collection, (2017), influence of cosmology on adoption.

6.3. socio-economical, ecological and technical feasibility and desirability

6.3.1. Emic reflection of the traditional cropping system in socio-economic terms

Rice intercropping systems

The traditional cropping systems are described by indigenous farmers as the upland intercropping system with rice, corn, garlic and

pumpkin. Rice is perceived as the key cultivar. The other crops, which are intercropped with rice may vary.



Image 11: Own Collection, (2017), Traditional mix of seeds for intercropping system.

This system is rain fed and therefore starts with the rainy season (normally in July). The fields for rice cultivation are prepared using slash and burn.

Five different varieties of local traditional rice are used. The rice varieties are different from village to village and adapted to the local situation. As mentioned before these varieties are characterized by their ability to grow on different soil qualities. Farmers choose the quantity sown of one specific rice variety dependent on the soil fertility and characteristics of the variety. Nevertheless, all rice varieties are cultivated every year albeit in varying quantities. The reason is that different rice varieties give harvest at different times of the year, therefore it is easier to coordinate harvesting. Furthermore, it is easier to preserve the rice as it does not have to be stored as long. The traditional method used to plant the rice has been described as a main characteristic of the rice cultivation. In Ratanakiri as well as Ta Veng, the upland rice is sown using long sticks to stab holes in the soil. After a group of men stab these holes a group of women follows with a bamboo sticks filled with rice seeds. The women put the seeds into the stabbed holes and close them with their feet. Afterwards the

process is repeated for maize. As a third step normally, a group of women sows singular pumpkin seeds. As mentioned the pumpkin is sown in places where they burned weeds earlier. Maize or pumpkin can be substituted by other crops dependent on the decision of the farming group conducting the intercropping. The crops chosen tend to vary except from rice depending on the decision of the individual farmer.



Image 13: Own Collection, (2017), Sowing pumpkin seed on ashes.

3.2.8.3. Fruit trees and vegetable gardens

Home gardening is mainly practiced during the rainy season. Local vegetables are cultivated nearby houses in mixed culture. Local vegetables include many types of cabbage, eggplant, local kinds of cucumber, pumpkin and many traditional herbs and leaf vegetables. These products are mainly cultivated for home consumption, although some fruits, vegetables, collected wild herbs and mushrooms are brought to markets by foot for sale. Every morning one can observe many indigenous people for up to three hours to the market in Banlung where they hope to sell vegetables and fruits such as bananas, pineapples and jackfruits.

3.2.1.2. Gender and social meaning of the traditional intercropping system

Gendered division of labour

The application of the technique to sow rice is strictly gender divided: Men stab the holes while women follow them and put the seeds into the soil. In a focus group discussion with male village members including elders and village chiefs, I asked about the traditional intercropping system. I was told that if I needed information about the traditional intercropping system I would need to ask the women as they are the experts. Women are responsible for the conservation of seeds and choosing the varieties for a certain year. Within the traditional cropping system women therefore have an important role and are responsible for crucial decisions. Men conduct the work which needs more physical strength. The main decisions about land use are made by men, albeit taken in negotiation with all family members.

Shared labour system



Image 14: Own Collection, (2017), Traditional preparation of the field for rice sowing.

The involvement of all members in decision is due to the shared labour system and the distribution principles. The work is conducted within a shared labour system and the harvest is shared with the members of a family household. Therefore, even when each family member has their own traditional land members conduct the labour together on these fields. Beside the individual land, so called community land is cultivated by members of the whole village. The harvest of community land provides resilience for individuals in the event of bad harvest on individual fields as well as contributing to community activities. Other “close persons” who are considered to be like family members and are called “brother” or “sister” and are invited to conduct shared labour.

Falling out of a shared labour system undermines resilience

If an individual does not provide help to others and participate in a mutual exchange of shared labour they will not be considered as someone who can be invited for shared labour anymore. These individuals, are for example people which have a regular job which makes them unable to participate. As they make money they are often pay members of their previous shared labour group to help on their fields. This could be considered as a falling out of the distribution principle of sharing based on general reciprocity. Therefore, it means a loss of the resilience provided for a member of a community. Being outside this community, an individual is considered as integrated into

the market system and has to act according to its distribution principles, paying directly with the exchange medium which is money. This means dependency on money for the individual as well as less resilience in case difficult economic situations arise. In the traditional intercropping system people are highly dependent on shared labour. Sowing, harvest and celebrating ceremonies for the rice spirit all require a significant amount of labour. Therefore, being integrated into the labour sharing system is essential for being able to conduct the traditional cropping system unless one possesses money to pay for workers.

Rice intercropping system is of central social meaning

The communal production of rice is reproducing social structures and maintaining relationships within communities as well as providing food resilience for individuals. Moreover, it reproduces gender roles within the community due to the gendered division of labour. As outlined previously, the traditional intercropping system is considered as a sphere of spirits. This means that when farmers are cultivating applying the traditional intercropping system they are interacting with spirits. Therefore one could interpret the agricultural activities within traditional rice production as a system of mutual responsibility for each other, spirits and humans, a system which is of central social meaning for village communities. As a consequence, it seems valuable to recognize the social reasons for decision making within traditional practices. That is why the central social meaning of traditional agricultural practices and how they influence the adoption of new ideas is explored in the following section.

6.3.2. Socio-economical barriers to adoption in the traditional system

Market opportunities for vegetables

The main customers are Khmer restaurants owners and sellers. These buyers often negotiate very low prices in comparison to comparable imported products. Indigenous farmers are regarded as bad business

makers and therefore expected to sell their products cheaper. One criterion to describe the inability of indigenous small-scale farmers is the way they sell per unit rather than by the ordinary per kilo. Sometimes indigenous people decide not to sell their products under these price negotiations because they feel disrespected. Instead they throw the products away and return home.

In Banlung market one can now find some rare places where indigenous people sell by themselves beside Khmer people who mainly sell imported products from Vietnam. One local extension actor has initiated an organic shop which sells local products not treated with chemicals. Farmers show a great interest in this project which offers several benefits to farmers/growers. The price paid for the products is higher and farmers can sell even smaller amounts. They can also negotiate via telephone before coming, which seems to be appreciated. While making the movie farmers met the woman who organizes the shop. She invited farmers to participate and many wrote down her number with the intention of bringing fruit and vegetable to her shop in the future.

The influence of shared labor distribution in decision making

Farmers who adopt SRI are having a hard time getting help due to following issues. Tom Poen farmers share labour tasks within the community. Connected to this they have to know how to apply traditional practices which they learn from an early age. These and new techniques need significant practice, as such indigenous farmers are regarded by themselves as skilled in traditional methods and efficient in their use.

“(...) when we grow by using SRI, they don’t like it (...) Some people helped us, but it was very slow.”

Farmers reported that compared to conducting traditional intercropping it takes a lot more time to conduct SRI. This is because the other members of the labour sharing system are not sufficiently motivated to apply the new method as its use is exhausting:

“We lost our labour (...) On the other hand we are so tired to follow the new technique that is very difficult, and our old technique is not difficult and fast to finish. “

If a farmer wants to teach others how to apply new methods, he would have to first ask and then train them. Farmers told me that this special demand towards members could be annoying for them:

“So, it means the people who share labour with us they can grow by using their own technique as they prefer. And if we want to grow by SRI technique they do not want to help us because we suggest them to follow the instruction. “

Furthermore, if the new method does not turn out to be successful it could lead to bad social reputation. In the facilitated collaborative learning process participants developed the idea of producing organic fertilizer for sale. When we discussed how to start this business the main concerns were the trustworthiness of the new method and the consequences for social reputation. Farmers agreed that they needed to experiment first to confirm for themselves that the product can fulfil their expectations, before selling. They explained this necessity as follows: if they sold the organic fertilizer and it caused any problems or did not produce the expected results they would be regarded as liars. Therefore, risk to social reputation may also be hindering the application of eco-efficient methods and also the transfer of knowledge about new methods.

Also highlighted was the close critical observations and scrutiny applied by other farmers when they conduct experiments. What's more, if new methods do not turn out to be efficient when tried they will often become dependent on others for additional support. To avoid these detrimental consequences small trials are often pursued first.

After learning about eco-efficient methods, another barrier to adoption is the culture of inherent learning based on experience. This will be elaborated on in more depth later in the chapter about learning processes.

The influence on gendered labor distribution in decision making

Importantly individual members cannot decide on behalf of family members which method they are going to apply; they must discuss

them and jointly agree. Due to gender dynamics men are, however, more informed about new technologies. There are many reasons for this. Men have greater privileges which increases their ability to access workshops compared to women. Men are more often more literate and speak more Khmer. Furthermore, higher percentages of men own technical facilities such as motorbikes and mobile phones. Men also have a more access to explicit information sources about new methods including books provided by local extension actors which they are more able to consume thanks to their literacy advantage. This gender division has and continues to produce obstacles for the application of new methods.

Women are in charge of key components in the practice of the traditional intercropping system: they preserve seeds and decide which varieties to use. In addition, they are considered to be the main implementers of seed sowing and management. Men are responsible for other major decisions, for instance which innovations to invest in. Often only one partner, (male or female) participates in a teaching program about eco-efficient methods. If one partner has participated in a workshop and would like to implement the received knowledge, he needs to transfer this gained knowledge to the other partner. The one who has not participated is more likely to be sceptical about the new methods feasibility. He or she may therefore be unwilling to implement them and it falls upon the partner to convince the other that this new method is desirable and feasible. The most common scenario is that the man has been introduced to a new technology, decided he want to try it, but first having to convince his wife.

Such conversations often produce disagreements which can discourage the application of eco-efficient methods altogether. However, during this research I came across an example where a female participant from our collaborative learning process decided to apply organic fertilizer on her entire fields. We asked if we could join while she applied it, she told us that she first she had to agree the time of application with her husband. Afterwards we wanted to know if she would have applied organic fertilizer in the event that her husband had disagreed. She told us “I would have done it anyway.” Rather than question the articulated gendered task division, I consider this as evidence of a gradual change in thinking and practice surrounding gender, encouraged by NGO trainings about gender issues.

Women groups are crucial to these discussions and play an important role in the ongoing fight for the realisation of women's rights. Not only to ensure that they get a legitimate and equal role, but also to protect women against violence. We were told by members of one women's group that if a woman does not feel respected, they will stand united and embarrass the husband for his behaviour. This has caused a reduction in violence and increased the power of women in their village. Some husbands were described as even afraid of women now.

Economic obstacles

As illustrated in Figure 8 one main hindrance is economic. As described before farmers have experienced a cultural shift towards market orientation and thus cropping systems have become associated with their potential to enter the market economy. The traditional system is perceived not to offer an entrance to the market resulting in some villages rice being moved to areas where it is not possible to grow other crops such as flooded areas. As the traditional intercropping system becomes less popular finding solutions for problems related to these systems are less desirable. This has led to the following: farmers are as mentioned above aware that the soil is not good enough to produce rice any more after years of rice cultivation on the same field. Nevertheless, they often do not perceive there to be a need to find solutions for the decreasing land suitable for rice cultivation, and hence cultivating rice becomes even more unattractive.

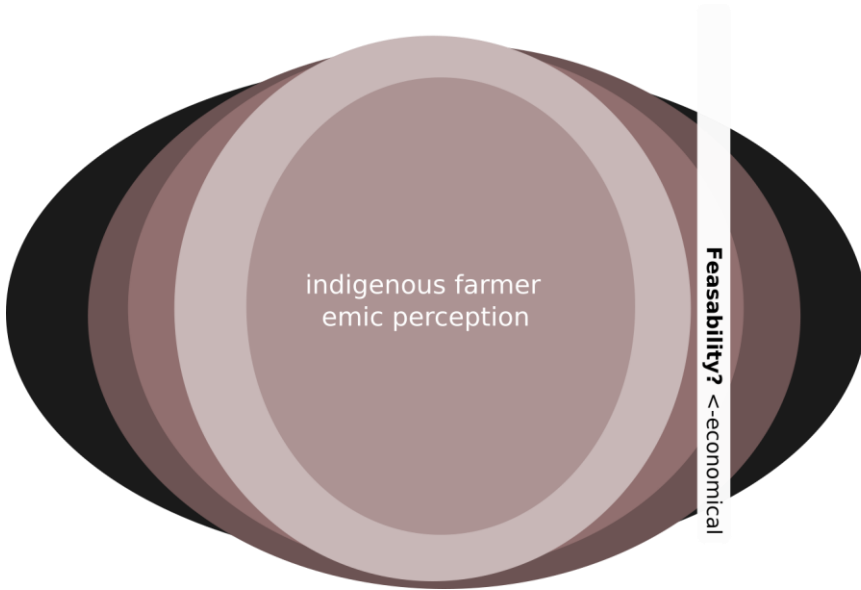


Figure 8: Own Collection, (2017), Economical feasibility.

6.3.3. Emic discourses encouraging reasons

Importance of the conservation of traditional varieties



Image 15: Own Collection, (2017), Traditional seeds prepared for sowing.

There are farmers who have searched for ways to preserve the cultivation of rice. One reason for their search has been the preservation of traditional rice varieties as carrier of cultural identity. Some farmers who participated in the collaborative learning process decided to cultivate rice again on fields they had abandoned when they learnt about organic fertilizer as a method to improve soil quality and as a result regarded the growth of rice again as a possibility.

Having said this, this is a culture of experience-based learning, thus hearing about these methods from an external agent or at workshops is not enough for any farmers. This barrier to adoption is discussed in section about learning processes.

Whilst there are several barriers to adoption, there are also factors that encourage the willingness to try eco-efficient methods and the continuation of traditional rice cropping system These will be outlined in the following section.

Discourse about pesticides

Pesticides are a new way to fight pests which some farmers have adopted. However, I could only find evidence of their use in new cultivation systems such as cashew (herbicides against weeds under cashew plants). In traditional systems I could not observe the use of pesticides. Nevertheless, it is considered by many farmers as threatening health, particularly when there are personal experiences of negative effects on health.

Unless they or someone close to them have experienced negative effects of pesticides, they do not tend to take it seriously. Rumours or secondary accounts are not enough.

When farmers are convinced by the idea that they are able to prevent or fight pests themselves and have experience pesticides as not a solution, they are encouraged to find alternative solutions.

Pesticides and fertilizers have constantly been called using the same term providing possible evidence that no distinction is made between the two methods. This could also mean that there is not a real understanding of how these methods function. They are more regarded as general medicines for plants recommended mainly by the chemical industry which provides promotional workshops for farmers in the villages. By distributing chemicals to farmers companies encourage them to try them out and gain experience.

Chemicals have a strong immediate and visible effect when compared to eco-efficient methods which seems to convince farmers of their efficiency. Nevertheless, chemicals are perceived by many farmers as toxic for humans and soil. For the participatory video project, we asked farmers to share messages with other farmers, many of which were about the detrimental impacts on human health. When we showed these movies during the final movie event it sparked an intense discussion about the experiences of farmers with pesticides and their health threatening effects. This awareness from experience with chemicals gave rise to discussions about the products they buy from

the markets such as imported rice from China or Vietnam. It transpired that the threat of toxicity through bought chemical products gives reason to maintaining subsistence farming and a crucial reason as to why farmers do not give up on their own rice and vegetable cultivation. However, even farmers arguing for the maintenance of rice had not been able to provide themselves with enough rice throughout the year since cash crop growth on the available land had been prioritised

6.3.4. Adoption of eco-efficient methods within ‘Modern’ Cash crop systems

Description of ‘Modern’ Cash crop systems

There are several cropping systems considered by most indigenous people as ‘modern’. The main systems observed were: irrigated vegetable cultivation on areas bigger than home gardens, cashew, pepper, fruit trees, long beans, coffee, cassava and rubber. These had been introduced by Khmer migrants in three ways. Firstly, Khmer immigrants seeking an income through agriculture started to cultivate these crops locally and also employed indigenous people on their plantations. In this way the indigenous workers observed these cropping systems. Secondly Chinese and Vietnamese investors had established plantations, on which they cultivate these crops on a large scale for export. Thirdly local extension actors, which at least in the beginning had been mainly Khmer, taught these cropping systems and advised farmers on their growth.

As mentioned before these “modern” cropping systems belong to the modern sphere in which farmers are not acting in relationship with spirits. The cash-crops introduced by Khmer seem to have become symbolic of the market system and access to money. Many farmers have decided to grow cash crops and abandoned the traditional subsistence intercropping system. As elaborated on above, when the Tom Poen cultivate using ‘modern’ cropping systems, they do not consider it necessary to maintain good relationships with spirits by

conducting ceremonies. Ceremonies, as mentioned before, not only maintain relationships with spirits but also within the community. This highlights a shift in the distribution principles inherent in the adoption of ‘modern’ cropping systems. If farmers grow vegetables, fruits or rice they have to share them within the community if they have surplus or someone is in need. This distribution principle does not apply to modern crops. Some farmers even told me that they do not want to harvest more vegetables because then they would have to share them.

Surplus or profit can now be owned. The distribution principle of sharing is substituted by the distribution principles of the market economy. As many ‘modern’ cropping systems need investment, farmers are borrowing money from community organized micro credit initiatives or banks. These initiatives are facilitated by local extension actors. However, some farmers do not succeed in their business or to invest the money. Farmers told me about other farmers who spend the money on motorbikes or jewellery. Some farmers therefore get into debt. Some of these farmers feel ashamed about their inability to pay back funds and decide to leave their villages.

When asking farmers, the reasons as to why they do not apply eco-efficient methods in one village complained that cash orientation leads to a loss of social reliability and undermines their sense of community. Consequently, cash crop orientation could be described a loss in social ties and socio-economical resilience. Hence, the shift in cropping systems is also a shift from “acting in relationship with spirits and community members” towards “acting as an individual in the market system”. Nevertheless, shared labour can also be found in these ‘modern’ cropping systems such as helping each other in growing cassava. However, sometimes this support is not provided on a voluntary basis as before, but instead in exchange for payment.

Integration into the market system through cash crops is considered a big chance, connected to many hopes “I love my cassava and cashew plants. I can send my children to school... When they get sick I lose everything. So please help me to find medicines.” Cashew nut cultivation is a means to access money and money as outlined earlier is desirable in itself as a means to be happy. Furthermore, farmers perceive cash crops as a way to make their life easier. From their

perspective they spend less time cultivating cash crops compared to traditional intercropping systems. There is no effort needed for trees due to their concept of trees being strong plants which don't need care.

Discouraging and encouraging reasons within 'modern' cropping systems

As explained before, many farmers do not apply eco-efficient methods because local extension actors have taught them vegetable production which seem for many farmers undesirable for the economic reasons already outlined. However, there are some farmers who perceive opportunities in producing vegetables with surplus for gaining cash. Remarkably I could only find one indigenous farmer cultivating in this way, all others cultivating in this system were Khmer. These farmers cultivate using a mixed cropping system, often with irrigated systems applied to up to ten different kinds of organic fertilizer and many different natural pesticides. They apply crop rotation and have fruit trees in intercropping with vegetables. The application of these methods has been facilitated by local extension actors including micro credit finance, teaching programs and excursions to meet other farmers and see their farms.

These farmers were inspired by other farmers, mainly from other provinces, who had been successful in producing organic vegetables. They also regarded organic crops as important for their own health and economical desirable. These farmers have reliable value chains through which they sell their vegetables and perceive organic vegetables as an income source. These value chains include the organic food store in provincial capital facilitated by an NGO and a constant customer base. As mentioned, these farmers are mainly Khmer migrants who know vegetable cultivation as a means to make money and had to learn to adapt to new environmental conditions. The move and change of context may have led them to be more open to new innovations.

Missing transfer of eco-efficient methods to 'modern systems'

Organic fertilizer

I could not observe any teaching programme which taught eco-efficient methods for cashew production. Many local extension actors are focused on large scale, irrigated vegetable production for the teaching of eco-efficient methods. The reason for this given by local extension actors and farmers alike was that the 'red soil' is very fertile and therefore there is no need to add fertilizer for trees. This belief seems widespread; so much so that I heard it from everyone I asked. This reasoning leads to a lack of organic fertilizer transfer for cashew farming. In the initiated collaborative learning process, EM-fertilizer was taught as also usable in cashew cultivation. Nevertheless when an organic farmer invited us to his farm he showed only his irrigated vegetable agroforestry and no cashew trees.

When we later evaluated the desirability of the methods taught some participants only interested in cashew and cassava production told us the following: "the methods taught have not been useful because we are not interested in growing vegetables." Asking why they do not apply the taught fertilizer it turned out that they did not feel convinced by it for the following reason: the farmer who has been applying has done so on his organic vegetable farm. Although he told them that he also applies it to cashew plants, they saw his vegetable farm with their own eyes. Therefore they did not know if he was telling the truth and whether it works in their specific local conditions.

Therefore, the transfer is discouraged because of scepticism towards the transferability of methods in between different cropping systems or other specific local conditions. This is connected to the way the Tom Poen verify and accept new knowledge.

Farmers are not convinced by the method because they did not see the application of the system. Cashew plants are perceived as a product which is easy to cultivate and provides more leisure time. It seems that the transfer of eco-efficient methods from vegetable systems to

cashew plants is discouraged by the conviction that red soil is of good quality for trees.

The organic fertilizer taught in the facilitated collaborative learning process was taught as being transferable to cashew cropping systems.

Furthermore, they were not sure if they could produce the organic fertilizer by themselves and if they could trust the end product as they do not have experience in producing it. Another reason was that they did not feel they wanted to invest their time and effort in the production of organic fertilizer as it is easier to buy it from the market. Remarkably they decided afterwards to buy organic fertilizer offered in the market to use on their cashew fields and tried to substitute the synthetic fertilizer usually used.

My assumption is that those farmers who expect to earn money by producing cash crops are willing to invest in this cropping system and spend money on herbicides, fertilizer and in seeds. In addition, some do not want to invest time in cutting grass by hand nor producing organic fertilizer themselves. Implying that there is something to the notion that they are lazy/value their leisure time.

One participant who became a main teacher within the project explained in the advertisement video that one of the main benefits of this organic fertilizer (EM-fertilizer) is that it can be applied to all crops. But however afterwards hesitated to apply organic fertilizer on his cashew plantation for the following reason: “I rent my cashew plantation to other farmers and therefore I don’t care about them.”

One businessman who rented a cashew plantation explained the following: “the one who is renting the cashew is having the risk for the harvest. Farmers who rent out don’t feel responsible.” Hence the renting of out of cashew trees discourages the use of apply organic fertilizer in cashew production.

Intercropping, crop rotation and mixed culture

The intercropping inherent in traditional agriculture is transferred into 'modern systems'. For example, cassava is grown together with cashew plants. The small cashew seedlings offer enough sunlight for the cassava, but when they grow tall the cultivation of cassava is stopped. I also observed cassava fields intercropped with other vegetables. To mix trees however was refused in many discussions. For example, in the final movie event farmers started to discuss the resilience which they receive by growing a mixed culture; when they grow vegetables, they have something to eat even in bad times. Moreover, even if one crop is attacked by a pest they still have the other crop to sell and if the price of one crop is low one year they can still sell the other crop. Nonetheless during the discussions that this perception does not apply to cashew trees as it is neither desirable nor feasible in the perception of farmers to cultivate cashew in mixed culture with other trees. One reason for this that other trees such as banana palms are too tall casting a shadow over the cashew. Besides, fruit trees are economically not desirable and space is limited so farmers don't want to waste it. Farmers often apply 'big scale vegetable systems' mixed culture, intercropping and crop rotation as a method for pest prevention. These methods are taught by local extension actors and inspired by other farmers who are already conducting this type of cultivation. Nevertheless, some farmers also grow vegetables such as long beans in monocultures.

6.3.5. Methods are not tackling the problems farmers are concerned with

Farmers and local extension actors observed recent outbreaks of pests and heavy attacks by diseases in cashew plants as well as in vegetables. They reported it being a new problem. Some farmers even cut down all their trees in order to grow them again as they could not harvest anymore from the attacked trees. The same applies to vegetables which some farmers decided to grow again. Although farmers articulated a strong need to find treatments for pest in cashew cultivation, there was a lack of knowledge about the treatment of diseases using organic methods. In the movie event of the participatory video project, farmers presented their "pest movies". These movies

had been collated by farmers filming pest and disease problems on their farms. Farmers and local extension actors present could recognize all of them and knew most of the methods, especially the “organic farmer” who knew how to prevent them in an eco-efficient way, except cashew pests which he had no prevention suggestions for.

Chemicals are available and their use is taught by the companies selling them directly to farmers. Considering the discourse about pesticides, it encourages farmers to seek alternative solutions when they have experienced the bad effects of pesticides. Nevertheless, herbicides are applied by many in cashew cultivation. Due to the lack of alternatives even farmers who do not want to apply pesticides owing to their awareness of their toxic effects decide to apply them. It is too much effort in from their standpoint to cut the grass by hand.

6.4. Reflections about the relationship between teachers and students

One key reason for not applying eco-efficient methods is found in the relationship between teacher and student. I call it an inferiority superiority paradox.

On the one hand farmers do not know how to face the challenges of recent changes. These recent changes are: decreasing soil fertility and the need to make an income due to new forces such as forest disappearance and emerging land scarcity, as well as new needs including technological facilities, driving farmers to shift from subsistence to cash cropping.

Khmer migrants entering the area are shown to have more experience in business and possess power over many indigenous people as they decide prices at the market where they are traders. They also decided land rights as governmental actors and many are owners of rubber and cashew plantation where indigenous farmers work. They own new technological facilities such as motorbikes which many have introduced to the region. Furthermore, they have introduced institutional education, school medicine and businesses including

many processed products. They have also introduced underlying cosmological concepts and paradigms that relate to these systems.

On the one hand farmers are aiming for access to the products offered by integrating into the distribution system introduced and dominated by Khmer. On the other hand, farmers are forced to find alternatives to their existing food providing systems embedded in very different underlying cosmological concepts and distribution principles.

This transformation process is forcing farmers into an inferior position in terms of power over access to technology, knowledge and decision making. Moreover, it puts them in an inferior position with their capability to act according to cultural codes and principles belonging to the dominating cultural index.

Ascription becomes self-ascription such as the emic and ascribed concept of laziness and stupidity.

6.4.1. Distrust in teachers and in new methods

Some farmers don't trust the competence of teachers when they are not active farmers themselves. They suspect that said teachers do not know about specific local conditions. Some farmers claim that trust in the competency of teachers decrease when they try to transfer agricultural practices from other locations. Particularly so when teachers do not have experience in the new methods they are teaching. In the emic perception one can investigate if teachers have competency by asking concrete questions. If they are not able to answer these it becomes obvious that they do not possess a real understanding of the methods they are teaching. Here farmers feel with their profound local ecological knowledge superior. Figure 9 shows the emerging superiority-inferiority dynamic.

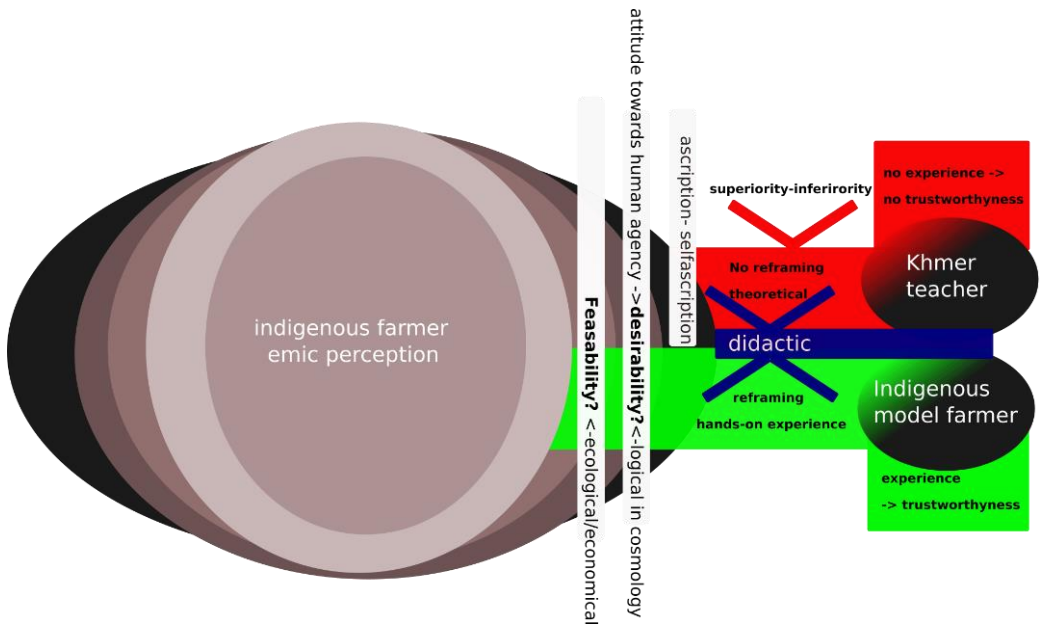


Figure 9: Own Collection, (2017), Superiority-inferiority dynamic.

Furthermore, some farmers experienced that trials conducted together with teachers revealed that the practices suggested by teachers were less successful than traditional methods. After conducting these trials teachers admitted themselves that the suggested method had failed in comparison to traditional method. Many farmers experience was that not only are the teachers, incompetent, they are also making fun of farmers/them. The decreased trust in the competency of teachers led to the questioning of the methods they are taught, connected to this, for many indigenous small-scale farmers putting the effort into trying these methods was not desirable. All in all, there was distrust in the competency of teachers and of the methods they taught. Bearing in mind that some of the methods involved an increased labour input, farmers did not consider them an attractive option.

6.4.2. Lack of mutual understanding

Farmers and teachers both expressed the feeling that they are not understood. Some teacher articulated that they felt as though it was like talking to children and that there is a need to develop the right mind-set of indigenous farmers. In general, it would be harder to teach indigenous farmers than Khmer farmers. One of the core issues raised by the teacher is that indigenous farmers are highly risk averse and have no knowledge about business. By risk averse they mean that they are sceptical about applying new methods. With business they meant that they don't have long term thinking and are unable to plan investment and profit. These were mentioned as the two main reasons why farmers don't apply eco-efficient methods.

Farmers, on the other hand claim that teachers do not understand their concerns or give clear explanations.

Within the cosmological understanding of indigenous small-scale farmers, belonging to different ethnical groups determines if one is being threatened by spirits or not.

Khmer and Vietnamese are not threatened by spirits because they don't believe in them and as such do not need to concern themselves with spirits. Therefore, Khmer people are not expected to understand or respect spirits. I would guess that this hinders communication between Khmer extension actors and the Tom Poen leading to decreased mutual understanding.

Farmers claimed that some explanations given were not clear. This could be due to different cosmological concepts which lead to different explanation models. Therefore, the explanation models chosen may not resonate with indigenous farmers. Farmers often claimed that the way teachers explain, is too complicated and hard to understand. When farmers received trainings conducted by indigenous farmers, they used explanation models which imply the elements of relationships, care taking and a comparison with the human body. This could be called a reframing in indigenous terms.

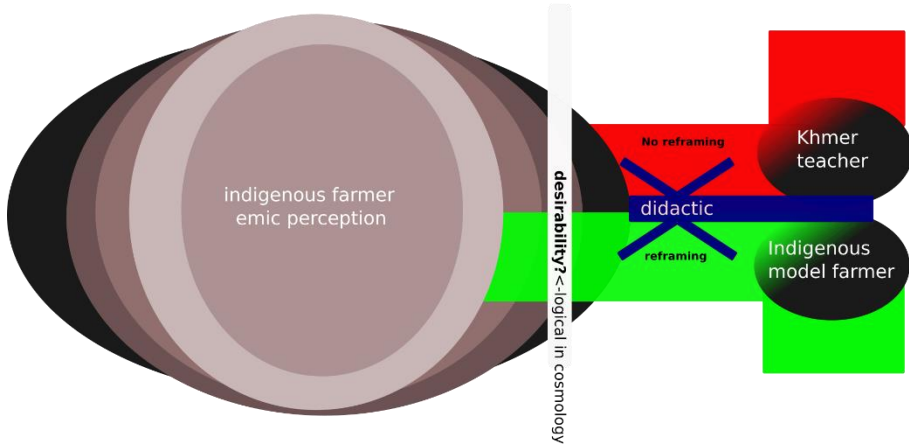


Figure 10: Own collection, (2017), *didactic (cosmological reframing)*.

One main issue was that farmers felt the need hands on training rather than receiving theoretical explanations about how to produce, apply it and its effects. This leads us to the question which way best transfers knowledge and encourages farmers to apply it?

6.4.3. Different learning concepts

Uncertainty of how to apply

Indigenous farmers mentioned that they learned how to produce organic fertilizer but it was too complicated and they could not remember how to produce or apply it. This lack of knowledge makes them unwilling and unable to try as they feel it is too risky to harm the soil through the wrong form of application in the collaborative learning process farmers decided to make an advertisement movie. They collected the worries farmers have about applying organic fertilizer. One main concern was that it could harm the soil if they don't apply it in the correct way. They explained that this happens when they had only heard theory and no practice.

Learning through experience

The inherent cultural knowledge transfer is through experience. When we asked farmers to teach other farmers they started the course by saying:” We want you to ask questions by yourself and we will practice because otherwise you don’t understand.” Afterwards the model farmer explained that he had learned about organic fertilizer during a teaching program delivered by local extension actors. He did not apply the methods because he did not understand when they only told him theoretically how to produce it. Afterwards he learned it from his father-in-law through practice and only then applied it. Similar experience was echoed by another participant. In the training which this model farmer organized he started the practice by introducing and presenting a booklet. This booklet explained how to produce the organic fertilizer. The farmers recorded the numbers exactly before practising it.

When we distributed leaflets explaining how to produce natural pesticides and fertilizer in the final movie event farmers were eager to receive one despite many not being able read and we got into trouble as we did not have enough for everyone. Despite being unable to read one farmer who later became a teacher could recall nearly everything after the first training. Nevertheless, at some points she became unsure and needed to call the organic farmer for consultation. Therefore, theoretical knowledge captured in leaflets supports the learning process for remembering but should never be used to substitute practice. Importantly it the possibility to consult with ones, teacher afterwards and ask follow up questions proved important. Once again, learning by experience plays a crucial role. In fact, it is pivotal to why or why not indigenous farmers are willing to learn.

Experiencing with the own eyes

Crucial to be convinced and therefore willing to apply eco-efficient methods is for Tom Poen to experience successful application first hand. A key part of the collaborative learning process conducted was the visit to the organic farm where farmers could observe the

successful application of eco-efficient methods directly. Most of the participants interested in vegetable production appreciated this farmer's knowledge. They observed that he was successful and became keen to try the method he taught. Furthermore, all learning processes which ended up in implementation of eco-efficient methods analysed were inspired by visits to other farmers who applied these methods successfully. The cultivation of cashew trees was also inspired by observing the success of other farmers.

Experiencing with their own hands

Within the collaborative learning process, a meeting to discuss the sale of organic fertilizer was held, during which farmers expressed that they were concerned that they didn't know yet if the product really worked. First, they wanted and needed to conduct trials to observe its effects. So even though they became interested in producing fertilizer and taught each other how to produce it, they did not yet feel convinced of the organic fertilizer as a business. Even seeing a neighbouring farmer using organic fertilizer with successful outcome was not convincing enough. They felt concerned that this farmer might be dealing with different conditions. They explained to me that they need to try it on their own farm, in their own local conditions to really know if it has the desired effects. Therefore, the method is not simply transferable from one location to another. In evaluations we conducted during the collaborative learning processes farmers expressed their interest, articulated the benefits of the methods they had learned about, but always referred to the necessity to try the method in their own conditions by themselves. In all learning processes observed experiments conducted by farmers themselves became key element to decide if they will implement a method. If experiments are not successful farmers will not apply the method tried. This bears the risk that farmers who have only recently got to know a method experiment with it in an unsuitable way. For example, some farmers in the collaborative learning process applied organic fertilizer on their fields with the expectations that they would see its effects within a few months, but the "successful" farmer told them that they would have to improve the soil quality using a combination of 3 different organic fertilizers and wait for some years to see the effects. This could result

in evaluating the method as non-effective due to lack of understanding the method.

It also means if it is not possible to conduct trials to validate fertilizer suitability, the new method may never be used.

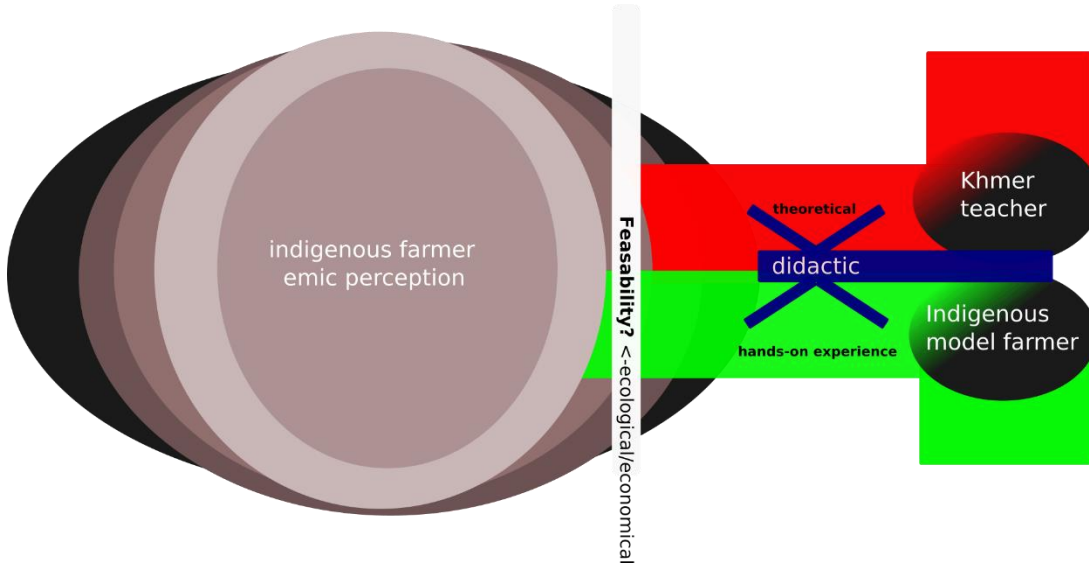


Figure 11: Own Collection, (2017), didactic (technical skills).

6.5. Elaborated Grounded Theory for this study

At this point, I shall transfer our findings onto an abstract level, resulting (with)in a Grounded Theory, which—in turn—is to develop a holistic understanding of why indigenous small-scale farmers in Ratanakiri become encouraged or discouraged to (not) apply eco-efficient methods. I view these farmers acting in a culturally conditioned framework that prioritizes (1) The Value of Relationship(s) over (2) the Objective Target Value.

Farmers find themselves constantly embedded in a moment of acting in relation to different beings, whether these are humans or spirits.

What they do, they do within two spheres simultaneously—the spiritual / transcendental one, as well as the earthly one. This means that the (possible) impact of their deeds has to be evaluated not just in their objectively perceivable / physical effects, but rather (and primarily) in what it causes to their respective relationship to the realm of spirits. The bilateral direct and balanced give-and-take reciprocity (as firmly upheld in Western societies) is foregone for an indirect reciprocity which focuses on a general involvedness in a network of relationships. By assigning importance and meaning to the maintenance of well-functioning relationships, individuals appease the spiritual relationship-sphere, and therefore incidentally create the pragmatic basis for simple survival: Whereas in some collectivist cultures trust-based long-standing relationships serve as an economic safety net in times of crisis, for Tom Poen success or non success is dependent on the concept of relationship rather than on individual skills. In the mentioned collectivist societies, this binary often comes as a side-effect, but the indigenous farmers see themselves dependent on the goodwill of their spirits. Success in life is determined by a causal relationship, i.e. the relation of an individual to powerful spirits. Individual performance cannot outweigh this assumed causality—so no matter how hard you personally strive for your goals, without an intact relationship to these spirits, your efforts will be futile.

These convictions are involved in a complex negotiation process in terms of cultural transformation.

Farmers who adhere to traditional farming methods display the ability to augment and partition their own system of one single cosmology into a set of cosmologies if adjustment pressure is exerted. In the eyes of the traditional farmers, the Khmer-farming immigrants who operate in a capitalist-based market economy, and who have introduced the so-called Cashew Cropping System into the Ratanakiri region, do not have to fear negative repercussions from deeds that are per se detrimental to spiritual relationships, as they move within a sphere distinct from the inherently spiritual one.

In essence, the adaptation process the indigenous farmers undergo on an earthly level, has its counterpart in their cosmological thinking. With the disappearance of indigenous forests that had been their most reliable source of nutrition, indigenous farmers successively applied the Cashew System. This act of integration enabled them to earn comparatively much money with little labour. Since—as illustrated beforehand—Khmer farmers (at least in the emic perspective of indigenous people) possess (and work in) a separate capitalist sphere, any acts indigenous farmers execute in this cashew cropping system, remain excluded from negative cosmological consequences.

Without this informational background, the inner tensions the indigenous farmers sometimes experience in the course of the decision-making process (i.e. whether to apply eco-efficient methods), cannot be thoroughly understood. Because, even if a farmer has taken the decision to engage in learning how to work with eco-efficient methods, this does not mean that he or she will eventually stick to them. This is where the element of relationship kicks in, with four variables at play: (1) The quality of relationship between teacher and student, (2) the kinds of methods the student is shown, (3) the way the new methods are presented and (4) extent of belief in spirits.

The superiority / inferiority dynamics that tend to permeate these relationships have a threefold cause. While, at a superficial level of conversation, indigenous farmers pretend to acknowledge the higher standing of Khmer teachers, they often underhandedly consider them incompetent, as they are no genuine farmers, and since they have never implemented the methods taught under real local conditions. This latent aversion puts the indigenous farmers in a dilemma as their successful integration into the market system depends on the knowledge they hope to acquire from the Khmer. A solution-oriented mode of communication is barely given because the Khmer often consider the native farmers lazy, stupid, and childish. This ascription of negative qualities is then transformed into a self-ascription, and used as an excuse to justify the non-implementation of eco-efficient

methods, accompanied by an inner blockage which impedes (or even negates) knowledge transfer between fully emancipated individuals (“I am stupid anyhow! So why even bother to try?”). The indigenous farmers thus remain in the roles they are assigned by extension actors. As an additional side-effect, the problems that really trouble the indigenous, seldom become clearly articulated.

This has to do with the fact that the indigenous (out of their fear of being misunderstood), do not share their cosmological conceptions (of farming), so that the Khmer—in turn—have no incentive to address problems in a culture-immanent framework. This conflicted initial situation of (mis-)communication does not allow for the emergence of mutual respect or appreciation, and eventually culminates in that the methods taught are incoherent with the to-be targeted problems, complemented by the non-integration of vital knowledge that the native farmers are equipped with.

Trust is a pivotal factor in this matter. A completely successful transfer of knowledge can be prevented by a mistrust in the sometimes purely theoretical lessons the Khmer give in workshops. Without concrete, visible evidence of agrarian success (i.e. outcome), the teacher’s credibility becomes undermined. The to-be learnt is not connected to a hands-on experience. How can the teacher’s instructions be of any trustworthy use if we have not witnessed their effects in our local environment? For the indigenous farmers, the acquisition of knowledge is bound to an associated experience, whereas theoretical knowledge distribution is judged as alien, and thus becomes inoperable. Even if natives embrace what they are taught in these courses, they may put themselves at risk by convincing the members of their respective labour-sharing group to follow their example: Should (for various reasons) group members fail at their implementation of the new methods, they may hold this (new) knowledge’s originator in social contempt.

Teachers sometimes do not reach their audience because they do something which appears completely logical and natural to us: They concentrate on the matter at hand and try to convey a knowledge of things—as opposed to explaining things in emic cosmological terms. If they go on to point out the possible improvement of a terrain’s overall fertility with the help of organic fertilizers, they present their students with a consternating concept, namely to improve a per se un-improvable element of (cosmological) nature.

A very straightforward problem is the discrepancy between wants and needs. What the indigenous—who traditionally grow vegetables and rice—expect from the lessons, is to gain information on how to monetize cashew. The teachers, however, literally ‘meddle on the natives’ turf’ by trying to integrate eco-efficient methods into their cosmologically-framed cropping system.

As encouraging components (to the learning process) indigenous may function in their roles as legitimized teachers; creating a credible synthesis of local affiliation and already proven and field-tested eco-efficient methods. If they hand down their knowledge to students, these may—in turn—experience themselves as (now) emancipated innovators who can even-handedly see the effectiveness of what they do differently. The simultaneous nurture of both (1) the earthly soil, and (2) the spiritual realm grants a culture-immanent re-framing process that gradually transforms the strictly cosmologically governed sphere into one that more and more incorporates active human agency. The relationship to actual and tangible soil is at least as vital as the relationship to a cosmological domain: Both require attentiveness and both have to be diligently taken care of in order to produce a positive outcome.

The following graph gives an overview of the key encouraging and discouraging factors.

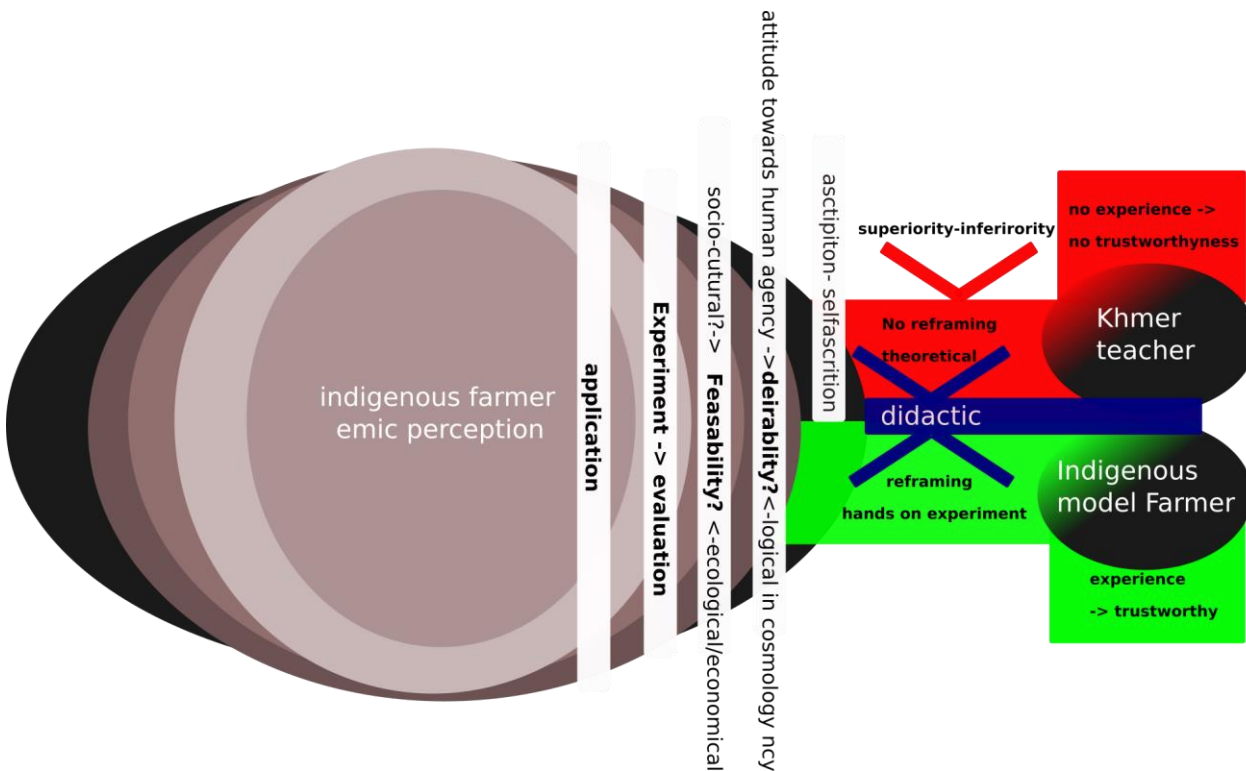


Figure 12: Own Collection, (2017), *Summary of boundaries to adoption of eco-efficient methods.*

7. Discussion

7.1. Embedding the results in the discourse surrounding sociocultural influences on adoption

We shall now embed the gained grounded theory in the discourse surrounding sociocultural influencing factors on innovation adoption (see Introduction). Therefore, I will reflect upon the grounded theory gained on an abstract level and identify the insights gained into critical factors influencing adoption processes.

7.1.1. Cosmologies are forming the attitude towards adoption of innovations

According to the results of this study, the attitudes towards agricultural innovations of farmers are interconnected to cosmological concepts and explanation models of phenomena. Despite the awareness of soil erosion as a major problem, the self-ascription of being able to solve this problem is shaped by underlying cosmological concepts. If farmers therefore do not feel enabled as humans to improve soil fertility, it would, in fact, be a pointless exercise to them. This is referring to Leitgeb et al. (2014) idea that conserving attitudes are supported by the conviction that exogenous factors are a cause of success, while the tendency to adopt is due to believing in the capacity of human agency. Therefore, I suggest that in order to understand attitudes we need to investigate the underlying emic concept of farmers in respect of the interrelation between human agency and concepts which are influencing the evaluation of innovations. However, my research findings also demonstrated that cosmologies are embedded in discourse of transformations in which complex negotiation processes of concepts take place. Individuals find themselves, therefore, in situations of controversy and integrate new ideas in traditional concepts. In respect thereof, it is not advisable to perceive investigated concepts to be permanent and coherent. Moreover, we should investigate the complex web of meanings and tensions experienced by individuals involved in the transformation processes of culture. Analysing farmers' emic explanation leads me to the conclusion that, instead of searching for causal and logical structures for explaining non-adoption, investigating these tensions between controversy concepts and negotiation processes might enable understanding the interplay between discouraging and encouraging aspects.

The results of studies in this discourse do not provide applicable knowledge, but rather the capacity to be aware of possible challenges and, henceforth, to gain capacity to react sensitively when working with local people.

With this I would like to remind that asking questions, rather than assuming knowing, is opening the avenue to dialogue which might foster a self-determined innovation process.

The meaning of eco-efficient innovations might not be comprehensive in emic cosmologies. This is a challenge and it is crucial to reframe ethnocentric concepts derived from science into local culture-inherent terms. An example of this was demonstrated by an indigenous farmer who was able to reframe the message of the benefits of eco-efficient methods in an appropriate way. Thus, a lesson to take away for extension actors might be the recognition that members of cultures are crucial to building bridges between cultures. Furthermore, the underlying logic of science is not a universal, comprehensive logic. Systemic approaches claim to be founts of 'legitimacy' and 'truth', but they are based on a biased simplification of complex relationships within aspects constituting reality (Funtowicz and Ravetz, 1993: 87).

Based thereon, I would like to articulate the claim that even ecological functions which might be regarded as obviously logical by some scientists are an integrative part of a specific cosmology which might not be understandable within other cosmologies. The ability of indigenous people to integrate new ideas within their cosmology encourages the adaptation of innovations but, at the same time, is initiating sociocultural changes. This highlights how crucial the emic ascriptions in respect of the meaning of innovation adoption are and, at the same time, how meaningful the outreach of the implementation of new methods is for the sociocultural context. Innovation adoption possibly becomes a sensitive topic in this manner, not only in obvious regards, but also in hidden cultural scopsis, which needs to be investigated because it could provide deeper insights into how harmful a method might actually be towards the sociocultural resilience. One example is the cashew system in Ratanakiri which undermines the principle of sharing.

7.1.2. Attitude towards innovation is formed by the quality of teacher–student relationships

It was clear from my results that another issue which needs to be considered is the quality of teacher–student relationships. Trust building has been shown to be crucial in the competency of the teacher. Therefore, it might be culturally specific as to which components are important for the evaluation of a teacher as being reliable. In similar lines, Kawarazuka and Thi Le Thuy (2016) observed in their studies of the minority Dao in Vietnam that knowledge transferred by farmers was pronounced as being more trustworthy than that of non-farmers (externals). Therefore, for Tom Poen, an important component was being an experienced farmer in local conditions and belonging to their culture, thus being knowledgeable in respect of their cosmologies. In other cultures, it being important to appear competent might possibly be an achieved status such as an academic grade. Furthermore, power relations might create barriers which I termed the ‘superiority–inferiority dynamic’. The elaborated superiority–inferiority dynamic is mainly caused by bias towards indigenous people, which leads to the integration of ascriptions into the emic rhetoric blocking communication. These barriers are hindering communication, which, in turn, leads to extension actors missing out on integrating local knowledge and encourages solutions which are targeting problems that farmers are facing. As elaborated above, the fostered empowerment of farmers could be supported by perceiving farmers to be experts. In acknowledging this, investigating gaps in adoption should consider power relations. Accordingly, I perceive these to be related to the claim of Beckford (2009) that top-down processes are discouraging a positive attitude towards innovations.

Based on the PV component of this research, I endorse wholeheartedly the widely accepted notion (Kawarazuka and Thi Le Thuy, 2016; Foster and Rosenzweig, 1995; Munshi, 2004; Singh et al., 2012) that social learning is encouraging adoption processes. However, the motivation and value perceived in social learning might also be related to culture and differ within collectivism-oriented cultures and individual-oriented cultures. The culture investigated in this study perceived great value in working together.

Equal to the observation of Kawarazuka and Thi Le Thuy (2016) in their study of the Dao minority, Tom Poen needed to observe with their own eyes beneficial effects before deciding to apply new methods. In fact, it became evident in this study that experiments are crucial to adoption processes.

In respect of associating individual characteristics of farmers to a tendency towards adoption, I could also observe that some individuals are more innovative than others. Age and education are often claimed to be a typical characteristic of innovative individuals (Cicek, 2008; Jha et al., 1991; Kassie et al., 2015; Rahm and Huffman, 1984; Shortle and Miranowski, 1986; Moser and Barrett, 2003; Warriner and Moul, 1992). This was not found to be the case in this research. Biography seemed to be of more importance than age or education. Khmer and indigenous farmers differed in their way of transferring knowledge gained in other farming systems to their own farm: Khmer migrants and indigenous people who had been forced out of their cultural context so as to integrate into other new conditions due to Khmer Rouge or losing land seemed to have higher curiosity in respect of new

methods. They were often inspired by farmers from other provinces in farming excursions organised by extension actors. It seemed as though they did not feel as sceptical towards transferring methods from different environmental conditions as the majority of indigenous farmers in Ratanakiri. This could be related to the adoption of another human agency concept.

Gender was shown to be discouraging factor to the adoption of eco-efficient methods due to the division of tasks and decision-making power relations. Having said that, in this project, women and men were equally involved and interested in adoption. Several obstacles in the adoption process could be observed as being especially true for women. Gender-related constraints are barriers to participating in workshops such as being responsible to take care for little children. When workshops are held in the Khmer language, women are less likely to participate because the rate of women talking Khmer is lower than that of men. Recognisably, some workshops had been organised with a translator to the indigenous language. Furthermore, workshops

should not rely on written booklets since many farmers cannot read. Farmers showed high interest in the written teaching material, so if the booklets would contain easily understandable pictures the message would more likely be understood by farmers.

Therefore, searching for alternative facilitator channels, instead of using communication channels which are reproducing gendered participation limitations, could encourage the participation of more women. Momsen (2010) and Moser (1993) claimed that the dependency status of women could increase due to modernising agriculture. This is worth consideration when reflecting upon adoption processes in Ratanakiri. When farmers stop growing traditional rice varieties, women's role of preserving seed become obsolete and with that their power undermined. The shift from subsistence farming towards cash orientation leads to the necessity of making more allocation decisions, as food has to be bought from the same money source as medicine and alcohol. This change in allocation strategies could lead to a more powerful status of the major decision maker in a household, who is usually male. However, as this is in a process of transformation for Tom Poen, it is not clear how household economy decision making will be connected to the gender power division. From an emic perspective, with regard to traditional Khmer, household decision making involves the sharing of responsibilities, within which men are responsible for earning money and women for distributing it. However, major decisions such as investment in a new house are made by men. Therefore, inviting the husband and wife together.

Moreover, as highlighted by Alarcòn and Bodouroglou (2011), Kassie et al. (2014), and Quisumbing (1995), women are often facing restrictions within markets. Indeed, indigenous women are very affected by the market restrictions. These are gendered, as women are in charge of bringing and selling agricultural produce, to the market in Banlung. Here they often face low-price offers, which they describe as disrespectful. The reason as to why it is mainly women bringing and selling fruits and vegetables to the market, and for the influence of the discriminating market opportunities on their status within their community, would be a possible interesting research question. Economic as well as technical issues were shown to be important factors in discouraging the application of innovations.

By choosing an approach in which the influence of economic aspects on adoption was analysed from the point of view of farmers' perceptions allowed for a deep understanding of the reasons. One economic constraint was the low market opportunities for vegetables and rice. Cashew by contrast is perceived to be a crop with very good market opportunities. Yet farmers are not investing in eco-efficient methods for cashew either. It was not immediately obvious why. However, they explained that trees are perceived to be strong and not in need of care. I suggest that these results provide evidence that investigating the economic factors without underlying sociocultural concepts does not give us a coherent understanding. In accordance with Knowler and Bradshaw (2007), the findings of this research also indicate that social capital has a strong influence on adoption processes such as labour sharing. For example, the higher labour requirement of some SRI techniques was shown to be a constraint due to the traditional labour-sharing system. Furthermore, the high complexity of new methods is a technical constraint because it makes it challenging to teach other farmers who are integrated within a labour-sharing group. These results demonstrate that social capital can not only have supportive functions such as those suggested by Hermans et al. (2013), Pender (2007), Wollni (2010), and Lee (2005), but also be a constraint if a method is undermining access to this social capital.

However, participants of the collaborative learning process conducted in this investigation formulated explicitly their motivation to collaborate with each other so as to be able to sell organic fertiliser, find solutions to their problems, conduct trials, and co-create knowledge by sharing their knowledge. This is in accordance with the key factors in collaborative action indicated by Hermans et al., (2013): (1) learning and knowledge co-creation, (2) upscaling and institutional entrepreneurship, and (3) outscaling and innovation brokerage. In discussions about a possible future project, collaboration among the participants was for each of them one main motivation to participate. Therefore, for these indigenous farmers, collaboration seems to be of a high value. In other cultures, it might not be the case, as people are thinking more in terms of individualism and competition. Reflecting cultural specifics are important, as Kawarazuka and Thi Le Thuy (2016) claim that there is a need to understand how processes of change in agriculture are shaped by historical and cultural values in

order to be able to facilitate adoption processes. As elaborated upon in my reflection of the method used I interpreted that participants have a tendency to see value in the relationship than for the objective itself. Consequently, cultures which are more objectively oriented in respect of collaborative action may not be as effective as cultures which are more relationship-oriented. The same might be witnessed in cultures in which farmers are sceptical towards collective structures due to bad experiences, e.g. in communist cooperation. Furthermore, trust is a key issue in generating successful collaborative action. An effort to build and maintain trust is needed in order to encourage collaborative action.

Rather than perceiving farmers to be rational farm managers, decision-making processes are complex negotiation processes in which contradictory concepts are involved and embedded in a cultural context of cosmologies, values and social structures. In order to understand farmers' thinking, we need therefore to investigate these processes and their emic perceptions.

Analysing farmers' emic explanations leads me to the conclusion that, instead of searching for causal and logical structures for explaining non-adoption, investigating these tensions between controversy concepts and negotiation processes might enable understanding the interplay between discouraging and encouraging aspects. This understanding I regard as being more suitable in analysing human thinking and culture in general, which is composed of complexity and controversy and has more fluent negotiation.

7.2. Reflection of the method

We shall now build on this analysis so as to reflect the chosen methods. The action research approach has a number of attractive features which will be examined in this section. Action research was shown to be particularly useful in studying the research question, as it opens the possibility to investigate the research question on three levels. Firstly, the participative mode gave the possibility to observe how indigenous participants are designing their own learning processes. Provided that indigenous people have culture-immanent ways of learning and

explaining, it made me aware of crucial components in the design of appropriate learning settings for indigenous people. As a case in point, consider the observed reframing process of concepts and the crucial meaning of experiments and sharing knowledge. The action research was giving me the opportunity to encounter incorporated cultural features which are not rationalized by farmers meaning getting a comprehension of the inaccessible. Secondly, the initiated learning process offered me the possibility to compare learning processes designed by indigenous people with those designed by extension actors. This gave rise to formulating a hypothesis about hindering effects due to the design of the learning settings. To illustrate further, teaching farmers perceived it to be a crucial element of their workshops to provide hands-on experiments to farmers and to share their own experience, while extension actors tended to explain by aiming for transferable theoretical knowledge based on agricultural science. I observed a different quality in the relationship between farmers and between farmers and extension actors. Thanks to these observations, I decided to investigate this notion further by conducting in-depth interviews. The adding of iterative cycles within the research as needs emerge is one of the strengths of the action research approach.

Thirdly, the initiated learning process evolved to become regarded as an experiment of alternative ways in which to conduct extension services in the local area.

For this reason, the action research fulfilled the aim of generating applicable encounters for local stakeholders in multiple ways. To take the most striking examples, farmers learnt how to apply EM fertiliser and, at the same time, alternative ways in which to provide extension services had been demonstrated to the involved extension actors.

However, there is an inconsistency with the argument when questioning the degree of participants' self-determination in creating the learning process. I would like to critically reflect my role as a facilitator in influencing the process. It needs to be considered that I was the one introducing the initial idea of meeting an organic farmer so as to learn from him about eco-efficient methods. While farmers fully decided upon the content, I was setting the framework in suggesting the PV method for conducting reportage. Some following

steps of the participative process were fully initiated by farmers, and for others I gave initial ideas which were discussed with farmers and adapted to their ideas. In a nutshell, one can say that the PV in itself was setting a framework of focus within which farmers were free to develop their own ideas and initiatives. For this reason, I have to admit my undeniable influence on the process creation and, therefore, reflect upon it while drawing a conclusion about culture-inherent ways to create learning settings. However, I would argue that it is possible to provide critical self-reflection so as to draw conclusions, especially as I used them to formulate a hypothesis which, in turn, was investigated more precisely.

As outlined in the section about PV, several authors or researchers have commented on the challenge of finding a balance as a facilitator in stimulating focus and directing in such a way that participants are developing ownership of the project. The importance of sensibility towards needs of participants and flexibility has been stressed by many authors, which I indeed experienced in this project. After a difficult period of trying to motivate people to participate, the initial visit of the organic farmer evoked a chain of self-initiated activities and upcoming issues, which persuaded me to react sensitively and as flexibly as possible to the ideas and needs of farmers. At the same time, I had to stay focused on investigating the research question and directing the process to the final movie event. In fact, it seemed to be a key challenge in my project to be very clear regarding what I was aiming to achieve, while being open to uncertainty and unexpected opportunities. Being a manager but, at the same time, an assistant was indeed a controversy which I felt was needed so as to achieve the aims. Another challenge that I could not find in literature was the constant necessity to adopt the management style to the culture-specific modes. Acting 'German' in terms of planning and being target-oriented, I experienced as being hindering or even making the process impossible. To illustrate this, I would like to give you an anecdote: I woke up one morning and decided that on this day I wanted to act German due to time pressure and to get things done. This need arose because of feeling that the permanent uncertainty and the need to react spontaneously were demanding a lot of energy and making the process difficult to fix in a pre-set timetable. Telling my translator my intention, she replied: "Oh, please not." Discouraged, we began the

day by trying to get to a village, but our motorbike broke down. This day ended up with our repairing the motorbike four times, making it impossible to conduct the number of interviews planned. In the middle of the day I received a call from one farmer inviting me to a ceremony — I packed my hammock and recorder so as to sleep in the village. None of that was planned but the opportunity to participate in a ceremony was very valuable to my research. Therefore, I decided that giving up on being German would actually open my eyes to the opportunities given. In fact, it ended up with full weeks being very busy by initiating and reacting at the same time and, furthermore, directing the work of my translators. The challenge was to give orders while not knowing what we would be up to. This highlights the crucial role of cooperation and integration of the translator into the project design by becoming a team. Becoming a team in this sense means pulling on the same strand. For the reason that I, as an outsider, had to learn to adapt to cultural modes, my translator being a team member and our reflections were crucial in overcoming intercultural barriers in designing the PV. Thus, my translators also had an immense influence on the learning process. In fact, concerns about how to facilitate and react sensitively towards the participants were becoming key considerations and reminded me of earlier experiences as a social pedagogue.

Another culture-specific aspect, which might occur also in other PV or action research projects, I would like to illustrate with an excerpt from my field reflections:

“When I turned around, fascination was spread in the room and I felt the tension in the air. Every kind of harmful or beneficial insect was crawling, running or flying on the screen. Farmers murmured excitedly to each other when they recognised a pest. It was as we were watching the most catching action movie and I realised I could have never created something which would catch the attention of the farmers in the same way. Looking to Poen, the farmer who created this movie, I could watch him growing with pride and, at the same time, I felt my happiness about it. And then I understood something. It is about caring and being cared for. It is about being taken seriously and being believed in and believing in. This is the key of commitment and dynamics in which people are striking for a shared aim together. And

more ... they find the courage to develop and realise their potential. I would say that it is key to the success of this project. By success I mean that we achieved shared aims. This meant that the self-initiatives of farmers were driving a collaborative learning process in which farmers shared and discussed their knowledge about eco-efficient methods. However, as much as we as humans might act in relation or to our caring about relationships, each individual need to feel commitment and self-determined meaning regarding the topic itself. Otherwise, people will follow, but not develop a self-initiative or become creative. The reward of being meaningful is probably mutual. A relationship itself becomes meaningful because it is connected to a topic which is meaningful and being connected through this strengthens the bond to care for each other as a person.

In this manner, I want to distance myself from the striking so as to be a researcher, a neutral observer who is influencing the field as little as possible. I guess that this leads to a debate, which is quite a struggle for many action researchers. Arguing that pure observation is not possible but that a relationship is needed for gaining trust and, therefore, insights into people's perceptions of reality could maybe relativize the concerns. And here comes the point: what about this feeling that many scientists as well as video makers might have felt sometime; the feeling that research takes information from people but that giving back is missing? I know this feeling when conducting interviews, and discomfort starts to climb inside of me regarding one-sided extraction of information. Relationships should not become a tool for extracting information and relating it. It feels dishonest to me. There is the insuppressibly need to give back. A respondent feels how real you are in the relationship, whether you care about him/her or not. This is where I see the strength of action research. One aim of the research approach itself is to initiate and facilitate meaningful and beneficial action for participants. The attitude itself feels so different to conventional research. Although there is the risk of losing yourself in action for the participants at the expense of keeping the research question in mind, it feels more applicable and coherent. I assume that participants sense a shared commitment and feel a trust in the researcher and this leads to more honest answers. The process becomes a shared aim and doors are opened to a world unseen. Having a mutual exchange with an element of expressed caring in the

approach to the research itself, seems to have the potential for coherent research findings. It is all about trust in the end, as the unveiling cultural concept is becoming naked. But how would it feel to stand in front of nakedness without respect, responding to the trust given to you to care? But let's talk more about this question: How much can we understand dynamics, perception and negotiation processes by observing events that we are influencing? I guess that we can by accepting and regarding our own influence as being part of the process that we analyse. This means that it would be a fallacy to underplay or ignore the extent of our influence. Instead of trying to minimize our own effect on the situation, we should fully engage in understanding our influence by being in a relationship. I know that this is a subject with a long history of discussion in social science such as anthropology (REF(S)). Often, however, the relationship is only the subject of relativization.

Taking into account the evident influence of that the relationship is necessarily affected by the fact that it is between insider and an outsider respectively between facilitators and farmers, we have to reconsider the research findings in respect of the learning process providing insights into culture-specific approaches to learning. Whilst there will necessarily always be some doubt about the findings of work into perceptions and values when 'outsiders' and 'insiders' come together, sharing knowledge within a space of trust and mutual respect is the most conducive environment for getting close to 'the truth'. I consider a key outcome of my investigation is the insight into the crucial role relationship building has for meaningful and sustainable learning and change to take place.

After reflecting upon the potential of action research in investigating the research question, I would like to focus now on PV in particular.

Participative video making served as a medium through which to support knowledge exchange between farmers and also initiate discussions and reflections in relation to resilience issues and potential solutions within the participants. For example, the invitation to the final movie event gave an occasion for farmers from different villages to meet with each other and with local extension agents and exchange methods, reflections and ideas. This I observed as happening rather

randomly in the everyday lives of indigenous farmers in Ratanakiri. Not solely due to the video making, but more to the initiated collaborative learning process, several farmers who had not shared their knowledge regarding organic fertiliser for years started to teach other farmers their knowledge. Farmers even expressed their interest in continuing to teach other farmers following the project. Thus, the action research project seems to serve as an impulse giver. In terms of Yamano et al. (2015) formulated suggestion to encourage farmers to engage in the learning and adoption process by increasing their self-perception, it seems that participative video making was supportive. It seemed to enhance the perception of the value of their knowledge and, therefore, encourage sharing and voicing opinions. The key idea in this project was that of regarding farmers as experts. Underlying was the observation of the outlined inferiority–superiority dynamic. The aim was to challenge the dynamic of biased ascription becoming self-ascription in situations in which indigenous people are together with foreigners or extension actors. Therefore, farmers became experts within the collaborative learning process, and extension actors as well as governmental representatives listened to them by watching the movies and to the farmers’ reflections. This could be regarded as fostering empowerment of indigenous people in terms of the outlined discourse surrounding the potential of PV.

7.3. Transdisciplinary discussion of suggestions

Based on the research results, it is possible find ways to increase adoption of eco-efficient methods by indigenous small-scale farmers in Ratanakiri. In this chapter I will outline recommendations for extension actors and research institutions. These are based on suggestions formulated together with indigenous farmers in Ratanakiri.

I found in my data collection that farmers demonstrate their systemic approach in the negotiation process, which they use to decide whether to apply eco-efficient methods. In respect to the complex and

multidimensional reasons for and against the application and their interdependency, I suggest that there is a need for a holistic approach to tackle the barriers and promote motivating factors.

One of the key discouraging reasons for farmers to adopt eco-efficient methods was that farmers are regarding the methods taught to them as unsuitable to tackle their problems. There are three facets of this:

- (1) Farmers are thinking in a systemic way but do not get the chance to observe the effects within a context if there are not demonstrative model farms.
- (2) Farmers' local knowledge of their traditional methods are not integrated.
- (3) There is missing knowledge about eco-efficient methods which address the threats articulated by farmers.

I suggest that, teaching single eco-efficient methods is inappropriate. Farmers reflect on interdependencies on-farm and within a local context. Therefore, eco-efficient methods be better implemented in the form of farmer managed experimental on-farm trials, which are mindful of the local socio-cultural, ecological, and economic context. Rather than developing single methods, farmers are able to innovate farming systems and adapt them to their situation. For example, the possibility to sell organic products for a higher price on local markets encourages farmers to apply organic fertilizer on vegetables.

The eco-efficient methods recommended should integrate and be driven by farmers' local knowledge. I will use this discussion to systemically evaluate the interlinkages of system components in a socio-cultural, ecological and economical context.

The recommendations formulated are a project design for the facilitation of the implementation of eco-efficient methods. As the aim of eco-efficient methods itself is to increase sustainability,

considerations and reflections about the methods in terms of sustainability will be integrated in the discussion.

This section is divided in three parts. The first part is a reconsideration of problems perceived by farmers, which I seek to tackle with eco-efficient methods. The threats to resilience for farmers are the starting point to formulate eco-efficient solutions. The second part of the chapter is a systemic project design for the facilitation of the implementation of eco-efficient methods to solve these threats. The third part is a set of recommendations and reflections about how to facilitate learning processes. This distinction was chosen as it allows me to first elaborate on the holistic framework and then focus on one aspect of the facilitation process in detail. The focus on the facilitation of learning processes is coherent with the research question, and the outcomes of this investigation serve as a source for formulating culturally-specific recommendations.

To reflect and present the design of the project in a holistic way, I used the peanut model, designed by Bawden and Packham (1998).

The following suggestions can only be regarded as ideas for a project or research design. To corroborate these suggestions, further research should include field trials in participative settings.

7.3.1. Outlined threats which need to be tackled by eco-efficient methods

Two months after conducting the final movie event, I arranged a meeting with different stakeholders and key participants of the collaborative learning process. The purpose of the meeting was to discuss potential further steps and solutions for issues, which had been identified within the collaborative learning process. It is relevant to

integrate the knowledge of all local stakeholders, in order to foster critical ideas in a holistic way and evaluate their desirability and feasibility.

Therefore, rather than formulating suggestions out of my experience and background knowledge, it was imperative to formulate solutions based on the knowledge of farmers and synthesize them with experiences of others reflected in scientific studies. The developed suggestions I will outline in the following and discuss them interdisciplinary in scientific terms. First, I will identify the problems which were identified during the collaborative learning process.

Problems identified

Pest outbreaks

Insect pest was pronounced by farmers as a major problem in all crops they cultivate. Furthermore, they articulated a lack of methods to fight these pests. In scientific terms it could have been due to monocultures that there will probably emerge uncontrollable outbreaks of pests. Indeed, as mentioned above this is already happening and some farmers cut down their trees and start to grow cashew seedlings again as they cannot have any harvest.

Another reason for pests attacking cashew is cashew being not from the area and therefore has not developed resilience towards the local pests. Also plant health might be vulnerable as the plant is not adapted to the specific environmental conditions.

One local extension actor reported high vulnerability of the cashew variety farmers are growing towards pests. Therefore, he is advising farmers to grow other more resistant cashew varieties. An additional reason for the pest and diseases might be the loss in soil fertility. This had been reflected by the organic farmers as well as by his choice of EM-fertilizer as an organic fertilizer which is in his terms means ‘feeding the soil and taking care of the plants at the same time’. Scientifically plants are less resilient and resistant towards diseases and pests if they are suffering malnutrition’s (Lawlor, 2004).

Undermining food security through loss of genetic resources

There is a rich diversity of local and traditional rice varieties found in Ratanakiri upland cultivation. This cultivation method is conducted by indigenous small-scale farmers. The rice varieties are adapted to the very specific conditions of rain-fed upland cultivation. Rice varieties from other regions are not able to thrive in Ratanakiri. According to farmers and local extension actors, Ratanakiri farmers are increasingly giving up on the traditional intercropping system in the upland because of perceived decreasing soil fertility.

This endangers the resilience of farmers as follows:

Based on a soil study of local farming systems, Tschopp (2017) maintains that the nutrient cycles are opened today. No active fertilization or fertilizer use had been observed (*ibid.*). This leads most probably into a decrease in soil fertility in the future if farm management practices do not prioritize the cultivation of closed nutrient cycles.

Soil probes of the aforementioned study could not find evidence that the soil quality is lower in soils on which cashew is cultivated than on rice fields. These results could indicate that even when land was converted from three years of rice cultivation to production of cashew, the soil has not experienced a decrease in soil fertility. However, the low number of soil probes used in the study should be taken into account when considering the study's results.

Nevertheless, farmers observed that leaves of rice turned a reddish color after three years of cultivation. Traditionally they interpret this as a sign of spirits' anger and desire for farmers to cease cultivating rice on this particular field. Scientifically the reddish color could be explained as Fe-toxication due to decrease in macronutrients over three cropping seasons: Fe toxicity can be triggered by high Fe²⁺ concentrations in the soil solution under anoxic conditions, e.g. in paddy soils. High Fe²⁺ uptake by rice plants mainly takes place when

there is a simultaneous deficiency of macronutrients; it leads to the formation of reddish brown spots (bronzing) on the leaves (Dorlodot et al., 2005). This is only one possible explanation which is not confirmed and further research is necessary.

Within these farming communities, there is an emic assumption that erosion, decreasing soil fertility, and scarcity of land have made rice cultivation impossible, while pest outbreaks have put increasing strains on cashew production. These problems are perceived by farmers as a dilemma situation: There are challenges and uncertainty to make a living by integrating into the market system, while there is a perceived inability to continue subsistence farming due to lack of knowledge of how to bolster soil fertility.

The pest outbreaks in cashew are forcing farmers to either find alternative ways of income - which most of them perceive as hopeless - or find ways to fight the pests. This leads into a debate which is vibrant within farmers about the health threat of applying chemicals.

From an agroecological point of view, the application of chemicals in an environment of monocultures can lead pests to develop resistance to chemical inputs (Georghiou, 2012)

Therefore, it does not appear reasonable to apply pesticides, in terms of efficiency. Besides other environmental impacts, pesticides are threatening the existence of important natural enemies and beneficiaries - such as soil microbes -, which contributes to a decreasing of soil fertility. Furthermore, pesticides are expensive investments which are proven to drag farmers into debt. This financial instability lowers the resilience of farming systems.

Food security of farmers becomes dependent on earning money to purchase rice. In many cases they become dependent on one single product, such as cashew. As many farmers grow the same crop, I posit that supply will surpass consumer demand, causing the price of cashews to drop. In fact, this has been observed by farmers and local extension actors before with other cash crops, such as pepper.

Contamination of pesticides of the rice in Banlung

As elaborated in chapter X Farmers are voicing a concern about the rice they buy in the market being contaminated. In light of these issues, it is clear that farmers' resilience is compromised as they cease to cultivate the traditional rice varieties or produce rice for subsistence. However, once farmers lose their indigenous rice varieties, it may be difficult to find other varieties which are well-adapted to the specific environmental conditions of tropical, upland, rain-fed rice fields in Ratanakiri. I suggest there is a need to preserve these varieties in order to ensure food-security. As such, it is important to foster feasibility and interest for farmers to continue cultivating traditional rice varieties.

Consider local threats in a global dimension

In a global dimension the loss of traditional rice varieties is also threatening resilience in food supply worldwide. In South-East Asia, a strong increase in yield resulted from the replacement of local rice varieties with high-yielding ones, as well as the introduction of synthetic fertilizers and pesticides. (REF) However, this shift in farming caused an immense loss of traditional rice varieties. The loss in genetic diversity in food plants reduces plant fitness and increases plants' susceptibility to climate changes.

“By serving as building blocks for farmers and breeders to develop new varieties, plant genetic resources are an insurance for agriculture to overcome future challenges such as climate change and increasing food demands” (FAO, 2012: 3).

A homogenization of plant gene pools can endanger our food security. Traditional varieties are locally-adapted and often resilient to certain ecological conditions (Bellon, 1996). They can be used to breed new,

more resilient varieties. For these reasons, it is important to preserve traditional varieties (Rogers, 2004).

In 2009, the International Assessment of Agricultural Knowledge, Science, and Technology for Development (IAASTD) suggests that input-oriented agriculture is not sustainable. The researchers came to the conclusion that small-scale farming, with diversity-oriented structures based on agroecological principles, is a sustainable farm system which could feed the world (McIntyre et al., 2009). However, small-scale farmers are often forced to give up agriculture because they do not earn enough income to survive (Shiva, 2016). One reason for this is accumulated debts, which accrue from expensive farm inputs - such as high-yielding seeds, pesticides, and synthetic fertilizer - as well as the low returns for agricultural products (*ibid.*)

High-yielding crop varieties have to be purchased every year. This makes farmers economically vulnerable, because they are dependent on the volatility of market prices(*ibid.*). In addition, high-yielding varieties demand a higher input of fertilizer to achieve a high yield(*ibid.*). An increase in the use of fertilizer can have negative side effects. For example, studies have shown the use of fertilizer can increase pests, like the brown plant hopper, in rice (Islam et al., 2009).

This causes immense losses. Salinization and reduction of soil microbes are consequences of applying synthetic fertilizer and pesticides (Shiva, 2016). Consequently, a yearly increasing amount of pesticides and synthetic fertilizer is needed in a farming system applying these inputs. The decreasing availability of locally-adapted varieties make small-scales farmer dependent on purchasing hybrids and applying synthetic fertilizer and pesticides (*ibid.*). While in Indonesia, I have studied the influence of the Green Revolution on small-scale rice farmers in Indonesia, as well as alternative ways that they are cultivating rice (Beck 2013, unpublished). One finding was that a hindrance to reducing pesticide application was the inability to obtain local, resilient varieties which require fewer chemical inputs (*ibid.*). As findings of several studies confirm, this hindrance contributes to a precarious economic situation for farmers, which leads to a secondary adverse effect on their physical health (Wilson, 2001; Altieri, 2003). There is an urgent need to preserve traditional varieties

in the hands of farmers, rather than seed banks, where native seeds are often unavailable for purchase.

Traditional varieties offer several advantages for small-scale farmers in general: Traditional varieties are reusable, meaning the farmer can save their seeds to use in subsequent years. Some of the traditional varieties have been shown to have a higher quality in comparison to high yielding varieties as they are more enriched by nutrition and some are easier to conserve (Hunter and Franzo, 2013; Esquinas-Alcázar, 2005). Consuming these traditional varieties can provide a better diet for farmers (*ibid*). Crops cultivated from these seed varieties could then be sold as organic. The higher-quality traditional rice varieties fetch a better price, thus boosting competitiveness for small-scale farmers on the national and international markets. This leads into the question how preservation by farmers is feasible and desirable for them. In summary, preservation of traditional rice varieties is imperative to increasing farmers' economic, ecological and socio-cultural resilience. This includes finding strategies to tackle erosion and the open nutrient cycles, in order to maintain soil fertility and create attractive value chains. Moreover, it is necessary to find pest management strategies which are able to prevent pest outbreaks.

In addition, another aspect, but one that this research did not go into is the effect on climate due to decreasing rain forest. Decreasing forest land in Ratanakiri has both local and global consequences. Equatorial rainforests provide a critical global service by transforming CO₂ to oxygen, acting as the lungs of Earth. Losing these forests causes climate change effects, which have trickle-down threats to food production, worldwide (Mahli et al., 2008). For example, indigenous farmers mentioned that reduced forest cover led to changing rainfall patterns respectively less rain. As this is a very broad discussion, it is not possible to deliver a satisfying contribution to this discourse within the framework of this thesis. Nevertheless, I perceive it as important to acknowledge these effects and try to consider them when designing eco-efficiency on farm trials.

7.3.2. Autotrophics and decomposition sub-system

Considerations

Results suggest that it is easier to innovate in cashew because it is a new system associated with the sphere of Khmer and a cosmological sphere in which it seems easier to integrate new concepts. Nevertheless, the superiority-inferiority dynamic could push farmers into the role of students, blocking the integration of the rich knowledge of farmers. Pushing farmers into the role of appliers rather than knowledgeable innovators can lead to threats.

Farmers' traditional system appears to integrate many agroecological principles; indigenous farmers demonstrate rich knowledge. Encouraging farmers to embrace their traditional system gives them the confidence to be innovative. Extension actors aimed to integrate farming methods, such as SRI (System of Rice Intensification) and the irrigated vegetable system, in the traditional intercropping system, but were unsuccessful. Both implementations proved incompatible with the traditional system and was difficult to integrate into a labor sharing system. There is potential in facilitating farmers to innovate their system by themselves, reframing and adopting indigenous concepts to build up a new consciousness for human agency, rather than asking them to adopt alien concepts.

Another innovation to the local system may be rice or other crops becoming interesting cash crops. It might be possible to encourage a transfer into a new cosmological sphere. Nevertheless, articulating rice as a cash crop might lead into a crucial change in associated concepts, such as distribution principles. Additionally, it could maintain the social principles and therefore strengthen social resilience. Realizing that indigenous farmers recently abandoned the traditional farming system it seems worth risking searching for a way to support social principles which are maintaining resilience such as distribution systems. It might be that the emic perception respectively the local attitude towards the traditional system will change as a result of innovation. These considerations are itself a potential research question which can only be clarified by observing what happens if farmers are deciding to innovate their traditional system. The decision

about cultural transformation should be in the hands of farmers. Farmers participating in the discussion about potential solutions also expressed an interest in innovating their traditional system. They perceive the traditional systems to be culturally valuable, thus worthy of sustainment.

In the proposal meeting with farmers and extension actors, we jointly developed the following crop cultivation design:

Farmers are cultivating a diversity of crops, varying from fruits such as banana, mango, papaya, durian, jack fruit, and pineapple, to crops such as rice, maize, peanuts, and vegetables. Legumes, such as beans and peanuts, are also integrated.

Agroforestry

The design discussed with farmers is an agroforestry system. For the purpose of consistency, the following definition shall apply to all mentions of ‘agroforestry’ in this thesis:

“Agroforestry is any land-use system, practice or technology, where woody perennials are integrated with agricultural crops and/or animals in the same land management unit, in some form of spatial arrangement or temporal sequence. Agroforestry is also a dynamic and ecologically - based natural resource management system. Agroforestry refers to the deliberate introduction or retention of trees on farms to increase, diversify, and sustain production for increased social, economic, and environmental benefits” (Atangana et al., 2014: 35).

In reviewing literature, agroforestry is articulated as a feasible and affordable way for small-scale farmers to maintain soil fertility: Trees can control soil erosion, maintain organic matter, fix nitrogen, and contribute to nutrient cycling (Young, 1990).

Agroforestry tends to have a higher genetic diversity, which can serve a pest preventive function. Hence, agroforestry systems are multifunctional. However, as covered later, agroforestry may have adverse ramifications on the overall farming system, counter-productive side effects can emerge.

Agroforestry systems are very complex ecological systems which generate beneficial effects through interaction of its interdependent components (Sileshi et al., 2014). Consequently, the soil fertility changes; microclimate modification; resource (water, nutrients, and light) availability and utilization; pest and disease incidence; and allelopathy in an agroforestry system are dependent on the interaction of the components within this net (Rao et al., 1997).

Key within the net is the interaction between perennials and annuals, meaning herbaceous or annual crops. This needs to be carefully examined when designing an agroecological system (*ibid.*).

In the following section I will outline the agroforestry design developed together with farmers, the reasons why it could be beneficial in the local situation, and necessary considerations which need to be examined in on-farm trials. Please find more detailed background information about agroforestry in the appendix.

General design of the proposed agroforestry system

Agroforestry is divided into two categories: Simultaneous systems and sequential systems. In the simultaneous system hedgerows or trees are intercropped or grown at the boundary of annual crop fields. In the sequential system, trees are grown in crop rotation with annuals, typically as a fallow. In the proposed design, both categories of agroforestry system will be integrated. As a simultaneous system, fruit trees and bamboo will be planted as a boundary on the edge of an annual cropping field. This way, the farmers may cultivate fruit trees

that are already found in the area. Likewise, the described traditional intercropping system involves farmers growing legumes and vegetables in an intercropping scheme with traditional rice varieties. This is done by applying their traditional methods and practicing shared labor. Additionally, cover crops are grown in the dry season on the fields. Farmers are conducting an improved fallow in terms of a sequential agroforestry system, to substitute the traditional fallow. The key of this improved fallow is to use selected species with specific beneficial effects on the soil fertility. A farmer can add organic matter mulch and vermicompost, as well. In order to improve the efficiency of nutrient usage, the Em-fertilizer - which farmers learned to produce in the collaborative learning process - will be applied.

Considerations about agroforestry systems in the Local Context

The traditional fallow systems practiced in this area contained all those benefits: Fallow systems overcome constraints on crop production through maintenance of soil fertility during the cropping period by recycling and conserving nutrients, restoring the soil's physical properties, and controlling soil borne pests and weeds (Buresh and Cooper, 1999). Thus, from an ecological point of view, fallows such as Shifting cultivation and Slash and burn are meaningful for soil generation. Due to land scarcity, short-term fallow seems to be a viable alternative. After taking account both the risks and benefits of agroforestry, I suggest combining the sequential and simultaneous agroforestry systems. In my proposed design, a simultaneous system would manifest in hedgerows serving as erosion barriers, while the sequential could be an improved fallow (Rao et al. 1997). Improved fallows tend to attain the objectives of natural fallows in a shorter time, through the choice of tree species, spacing, density, pruning, and establishment. For example, fast-growing leguminous trees are chosen for replenishment of soil fertility (Atangana, 2014). This improved fallow is a short-term version of the traditional shift-and-burn fallows with purposeful cultivated tree species, spacing, pruning and establishment. By leaving the land fallow, one would act according to the convictions of farmers that land needs to rest. However, the element confusing in the emic logic is that short-term fallows are

managed fallows in contrast to natural fallows. It might be that the human-operated fallows are not comprehensive in the traditional ideology as, here again, human agency is a key element. Nevertheless, cashew is regarded as a possible fallow crop, once rice is not able to grow on the soil anymore. Farmers might adopt other trees too as fallow crops as trees are perceived to be stronger than rice. However, cashew is integrated in the traditional cosmology as a different sphere of being deliberated of the influence of spirits due to the perceived association of the cropping system with Khmer. These reflections make it obvious that one cannot forecast how farmers will perceive these fallows and how they will integrate them in their cosmology.

While the short-term fallow is in accordance with the conviction and concept that soil fertility is gained through a process of regeneration by letting the trees grow, cultivating trees purposefully might appear contradictive to the traditional idea of the natural re-growth. This change may undermine cosmological interpretations. Meanwhile, a possible assumption is that if farmers are able to preserve their traditional farming system, they are able to maintain resilience because they are able to retain their cultural identity and socio-cultural institutions (such as ceremonies, labor sharing system, etc.). However, some research shows (Ironsides, 2013) that the communal land concept is crucial to preserve the rotational system and social institutions (e.g., conflict management institutions). Therefore, not only ecological features are playing a crucial role in the maintenance of resilience but also land rights. This political aspect has to be taken in account by searching for eco-efficient solutions as well.

Another issue which needs to be considered: It might be problematic to convince farmers to cultivate trees only for the purpose of leaving it fallow, as they need to earn deeds with their scarce land to sustain their life. As observed during this project, they already decide to adopt cash crops at the expense of traditional fallows. The challenge question is: Is there a way to leave soil fallow and gain money with the fallow crops at the same time?

In the discussion with indigenous farmers they came up with the idea to divide their fields in two parts to conduct a crop rotation system. On one part they would grow the traditional intercropping rice system and

on the other, peanuts with soybeans. They considered this system to be efficient with regard to the possibility of earning high rice yields again. Peanuts would be grown as well as the traditional intercropping rice system, but only in the rainy season. The soil left bare in the dry season is exposed to erosion, causing it to lose soil fertility. Eventually, a rotation system, within which the soil is covered in the dry season, could result in multiple benefits. One option is to explore the benefits of using *Cajanus cajan* (pigeon peas). These are often integrated with other crops, e.g. in the traditional intercropping system. After harvesting the annual crops, the pigeon peas are left on the plot for a second year. The pigeon peas are harvested the next year, the residues are burned or incorporated in the soil, and the intercropping system is grown again. In the third year, the cycle restarts with the cultivation of pigeon peas being intercropped in the intercropping rice system.

Pigeon pea is advantageous because it does not lower crop production. There is even an increase in crop production (80 % for maize and 97 % for peanut) after a *Cajanus* fallow. This increase has had a positive effect on the adoption of this technology (Degrande et al., 2007). Other reasons for adoption are soil fertility improvement and weed suppression (*ibid.*). Advantages listed by farmers include the reduction of the fallow period, the availability of pigeon pea beans for consumption, the ease of clearing of a *Cajanus* fallow - especially for the women -, the ease of planting peanuts on a plot where *Cajanus* had previously been cultivated, and the direct seeding of *Cajanus*, which requires less physical effort than alley cropping establishment (*ibid.*). In addition, the increased crop production from the practice occurs quickly, and its profitability has been demonstrated (*ibid.*).

In Nigeria, *Cajanus* fallows increased maize production by 200 % and that of groundnut by 350 % over 6 years. A *Cajanus* fallow, pruned at 60 cm, was also found to be suitable for livestock production in savanna zones (Agyare et al., 2002). In the same region, *Cajanus* fallows were found to increase maize grain yield between 0.43 and 2.39 Mg per ha in the first year after fallow, but with yield decreases in the second year by 17.6–50 % (Abunyewa and Karbo, 2005). The same study revealed that after two years of a fallow period, there was an increase in organic carbon in the soil, as well as an improvement of

total nitrogen by 48.5 %, and CEC (Cation Exchange Capacity) by 17.8 % (*ibid.*). There are two major constraints with the adoption of this technique: seed supply and storage of *Cajanus* seeds (Degrande et al., 2007). *Cajanus* fallow, along with other rotational fallows, has also been found to increase soil infestation of snout beetle (weevil, Curculionidea) in maize farms in Eastern Zambia (Sileshi and Mafongoya, 2003). Snout beetle is a major pest for maize production; therefore, some landowners are likely to be discouraged from adopting *Cajanus* fallows because of this negative factor.

Another possibility might be to operate a sequential fallow system in a time frame which farmers normally do not cultivate crops: during the dry season. Trees might be feasible cover crops as they have deeper roots than annual crops and because of the ability to reach into the water reserves in the subsoil; they can endure with less water in the topsoil. However, it may prove difficult to find perennials which develop roots in five months and are also adapted to endure dry seasons.

Tree fallows, however, do not increase the supply of P in the soil, although they may increase P availability within the system. Therefore, crops cultivated on P-deficient soils after tree fallows will need P fertilizers to fully enjoy the benefits resulting from the fallow. Detailed information are to find in the appendix Agroforestry.

Global reflection of agroforestry

Besides local benefits of agroforestry, cultivating trees is also globally crucial in the tropics. There are three major climate functions of trees: They can absorb carbon from the atmosphere. Secondly, they have a cooling effect by absorbing sunlight. Thirdly, the mechanism, called evapotranspiration, is caused by trees drawing water from the soil. This leads to cooling (Swaminathan, 2007). As a study showed, the natural carbon sinks created by trees are only able to function effectively in tropical regions (*ibid.*).

One can conclude that some practices suggested by farmers offer to address ecological issues in Ratanakiri, such as loss of soil fertility. However, they also provided insights in trade-offs and many open questions which need to be investigated. For example, there is a need to identify locally-specific components which are appropriate to integrate in the farming systems, e.g. local tree species. For this reason, local ecological knowledge of the indigenous farmers becomes crucial. In my field stay I observed an immense knowledge of farmers about the usage and characteristics of trees. To illustrate this, they used trees to harvest waters in the jungle by burning holes inside of the stump. They showed a rich knowledge about medicinal properties of plants. Likewise, the discussion gave us an insight into the interconnectedness of eco-efficient methods with socio-cultural spheres. It provided some ideas of how adaptation strategies could take into consideration the cosmological concepts of the natives, while encouraging valuable ecological features, e.g. the short-term fallow.

Referring to the reflections about pest management in agroforestry system (appendix chapter Pest management), research needs to indicate interactions in the local specific ecological conditions.

In general, we should identify local plant species which are tolerant and resistant to insects and pathogens (Atangana et al., 2014). Increasing the diversity within trees also showed to have pest aversive effects (*ibid.*). These management strategies would need intensive experiments and trainings with farmers.

Alternative crop rotation

Some participating farmers observed other farmers in their villages conducting crop rotation systems, which combined the traditional intercropping rice system with peanuts in mixed culture with corn. This system showed promising results. The idea now is to conduct the

traditional intercropping system, as described in detail above, and rotate this cropping system with an intercropping system of peanuts and corn. Peanuts are leguminous and could therefore enrich the soil with symbiotic fixated N. This crop rotation should be three years long. Therefore, it would take possibly two years longer than the suggested sequential fallow. Vertifer grass could be planted as a cover crop and could also provide fodder for livestock. However, this non-local grass could become an invasive weed.

Another obstacle could be the provision of water for the grass. This could be provided by bamboo as water pumps. Bamboo could be integrated within this intercropping of fruit trees. They have the potential to function like a water pump (Lipangile, 1985). This system is used traditionally by indigenous farmers to gain water. In one village I observed a small bamboo area in which bamboo sticks were pulled into a hill to gain water. This water source was the central washing place and villagers picked up their drinking water there. They preferred this water source over pumps built by extension actors. It might be possible to use the water gained by the bamboo for irrigating in the dry season, and to grow legumes as cover plants in terms of conservation agriculture. Nevertheless, the more complex a system gets the more difficult it might be to adopt. To sum up, I regard the sequential fallow as a more promising idea, especially as it might seem more logical within the fallow concept to increase soil fertility of indigenous farmers. One needs to bear in mind that local species should be used as if not local, it is also here important to bear in mind the potential problem of evasive species.

EM– fertilizer

The successful farmer, who participated in the collaborative learning process of this investigation, decided to teach EM fertilizer. He claimed that this kind of fertilizer has multiple effects, particularly on the suppression of pests. This EM fertilizer needs to be combined with a fertilizer or soil improver containing organic matter. As mentioned above, farmers concluded in the discussion that there is a need to learn about a compost which can be combined with EM fertilizer. But

compost is a soil improving material rather than fertilizer as it is rather low in nutrients in a form available for plant uptake. It contributes to soil fertility and nutrient availability in an indirect, and more long-term way.

Reviewing the literature on EM application, I could only identify long-term studies conducted with EM fertilizer and compost in combination but none with a control of EM fertilizer without additional organic matter or mineral containing fertilizer. Moreover Javaid (2010) draws the conclusion based on the state of art

“(…) that benefits of EM can be best exploited through their repeated applications for few years in combination with organic amendments and applying them as foliar spray. Integrated use of organic matter plus beneficial microorganisms with half mineral NPK can yield equivalent to that of full recommended NPK fertilizers dose. Beneficial microorganisms can also be used for wastewater treatment, pest and disease management, and to reduce the abiotic stresses on crop growth and yield” (Javaid, 2010: 348).

One often-applied combination is inoculating EM to fermented organic matter, called EM Bokashi (Xu et al., 2001; Yan and Xu, 2002).

A possible conclusion, in respect of the outlined function of EM, could be that EM is not increasing soil fertility per se, but is increasing the availability of the different aforementioned components. If vital plant minerals such as N, P, K, and C are not added to the soil system, the soil fertility will decline once these nutrients are used up. Therefore, due to the outlined benefits, EM is desirable to apply. It is useful for increasing the availability of the bound nutrients in the red, high pH soil in Ratakakiri (Tschopp, 2017), a soil which has the effect of P being attached on soil particles (Blume, 2010).

Heterotrophic and decomposition system

Suggestions:

Based on research and results from the thesis project, I suggest promoting the active use of farmyard manure, as it is rich in P and full of N (Blume, 2010). Obstacles for manure provision are experienced due to decreasing number of cattle owned by indigenous farmers (Tschopp, 2017). Pigs and chicken are commonly kept close to every household and are allowed to walk freely through the villages. However, fields are far away from the villages where the chicken and pigs roam. Therefore, it is challenging to collect the manure and bring it to the fields. In addition, narrow trails leading to the fields pose as a difficulty for transporting larger loads. Another obstacle is distributing the manure on fields. An idea could be to keep pigs directly on fields in the dry season. However, there is a threat that the pigs may feed on the cover crops. On the other hand, this could be an opportunity if cover crops are planted, which are suitable for feeding pigs. The planned pigeon peas are in fact regarded as suitable fodder. Pigs provide an important source of manure for the local context, as their dung has a high content of P. Nevertheless, the amount of pig manure might not be enough. Another idea could be to increase the amount of cattle kept by organizing groups. Nevertheless, there is not much land available for grazing. Farmers in these groups could breed cows to increase livestock numbers in the village by means of cattle sharing system. This would make a first investment into cows a necessity, which raises the question of who could make this donation. If donors are giving cows, it could raise the expectations that more cows or material means will follow. This is a critical consideration within a project which aims to regard farmers as fully-enabled actors who are independent of material donorship. How dangerous donor ship can be is reflected in some studies such as Moss et al. (2006) and Cooksey (2012).

If cows already owned by farmers are used for multiplication within self-organized farmer groups, some issues might arise in organizing such cooperation. It might be possible to increase the population of cows by raising awareness for their use on fields. This might be the main obstacle to face: How is it understandable for

farmers to apply manure on the fields? Applying plant residues, cultivating in crop rotation, and using fallow methods are not alien to farmers within their traditional system, but applying droppings of animals is rather new. A follow-up research question to this thesis could involve the reframing and integration of the concept of manure application in agriculture. The organic farmer as a teacher gave the idea of using a synonym or symbol to the ceremonies in which the spirits are fed by a sacrifice, such as a young bull. In his concept, the soil needs to be fed. It might be that it appears logical for farmers within this concept, that the soil also needs to be fed by droppings of a cow. Interestingly, the organic farmer did not choose to describe manure within his teaching. Nevertheless, this cannot be answered and remains open as a research question. Keeping cattle or pigs could lead to an increase in economic resilience for farmers, because pigs and cows are serving as savings for financial shortcuts.

7.3.3. Management and Allocation sub system

In this section I will shortly consider which issues might emerge when searching for alternative income sources when replacing the main cashew cash crop cashew with agroforestry systems. The aim is to increase feasibility and desirability for indigenous farmers to cultivate traditional rice varieties. One aspect of attractiveness discussed with farmers is the possibility to earn money with rice.

Allocation of Products (Distribution)

Based on the results of this thesis investigation, there is a need to find alternative income sources to cashew. Farmers believe that, due to the shift from subsistence to market orientation, there is a need for finding attractive income sources. Farmers explained that if they can sell rice for a better price they would be interested in continuing cultivation. The same applies to other traditional cropping systems, such as vegetable home gardens and fruit trees. Farmers could sell their products on the international market or inland market. For both options, value chain building would be needed, within which farmers are connected to customers who are willing to pay a higher price.

From a sustainability perspective, selling organic products on the international markets would be considered as a controversy: Stephen Gliessman, a prominent researcher in agroecology, considers bioregional food production to be able to establish “real relationships”, in which it is possible to share knowledge and information (Gliessman, 2015). He posits that international markets can encourage a disconnection, which would cause a decrease of small-scale farmers while increasing farm size, as the only aim becomes increased productivity (*ibid.*). In these terms, it would be more sustainable to sell the products on local markets and to enhance the awareness among the local consumers about the benefits of organic products in Ratanakiri. Is this feasible? Several studies about the consumer’s motivation to buy organic food found that consumers decide to pay more for organic because they perceive it as better for their health (Bruhn, 2001). As mentioned, there is a discourse I observed in my field studies about the health threat induced by food products treated with pesticides, as well as an appreciation for organically-produced products. Kropp und Seherer (2004) pointed out that cultural attitudes strongly influence the motivation to buy organic products. Apart from this, the socio-demographic aspects strongly influence the motivation to buy organic products (Krystallis and Chryssohoidis, 2005). In Europe, analysis about consumers who buy organic products shows that the majority are well educated with good incomes. To gain the interest of people with less income is harder (Lüth, 2005). It might be challenging to find lower-income costumers willing to pay a higher price for organic. Nevertheless, local eco-tourism may provide potential opportunities to sell traditional varieties for a higher price.

Another problem can be considered in terms of sustainability: Encouraging the production of rice for the market could lead to farmers selling all products to the market, instead of using some for self-consumption. This could have a negative effect on socio-cultural resilience. While aiming for maintenance of socio-cultural structures and identity associated with the cultivation of traditional rice, encouraging the perception of rice as an attractive cash crop could induce an undermining cultural transformation. As elaborated in the results chapter, changing cosmological concepts associated to cropping systems indicate which dimension a possible change could emerge.

Another aspect, in terms of sustainability, is the loss of nutrients from a local environment through global trade of agricultural products (MacDonald, 2015). Furthermore, the transportation of agricultural products to Europe is very fuel intensive (*ibid.*). This leads to climate gas emissions as well as the use of a non-renewable energy source (*ibid.*). Therefore, in order to foster sustainable economic development, creating local market opportunities might be more favorable than export orientation.

Finding ways to balance cash crop production and subsistence in order to ensure food security and sustainable livelihoods should be an aim at any rate.

Operation

Value chains

Farmers are integrated in the labor sharing system. As a new element of collaboration, we discussed the organization of a cooperative.

Cooperatives strive to support small-scale farmers and are regarded by several institutions as a promising opportunity (Raynolds, 2004). A worldwide tendency is that small-scale farmers are forced to give up agriculture because of overwhelming competition with large-scale farmers (Karantinis, 2015). Karantinis suggested that the formation of

cooperatives could be a way for small-scale farmers to survive in political and socio-economic conditions which often favor economies of scale. In respect to this argument, many initiatives which strive to support small-scale farmers implement the formation of cooperatives and combine the principles of fair-trade projects and organic cultivation (Raynolds, 2004). Through internationally-recognized certifications, farmers are enabled to sell their products as certified on an international market. The customers are willing to buy certified products for a higher price (*ibid.*). The concept of fair trade is focused on economic and social well-being of the farmers, composed of regulations which set a minimum wage and forbid child labor. Organic certifications are more focused on ecological sustainability (Raynold, 2000).

For example, a study of organic cotton cultivation in India shows an improvement in the livelihood of small-scale cotton farmers due to a combination of fair trade and organic principles (Eyhorn, 2007). Being organized in a cooperative provided the means to earn more money by selling certified cotton to customers from Western countries, who are willing to pay more for fair trade and organic cotton. Furthermore, they cultivate without pesticides and because of the use of organic manure, they could improve the soil fertility and their health conditions as well as lower their input costs (*ibid.*). The transaction costs, such as certification processes, could be paid within a collective fund of a cooperative. In the case of a Kyrgyz cotton cooperative, one farmer by himself could not offer enough cotton for a trader to sign a contract (Beck, 2015). The cotton farmers needed to collaborate with one another to offer a volume which enables them to maintain a business relationship with an international trader (*ibid.*) There is also a need for education on organic cultivation and on building up a production chain (*ibid.*). For those reasons, it being organized in a cooperative is beneficial for farmers (*ibid.*).

There are some challenges for maintaining a sustainable cooperative. Beck (2015) investigated the consequences of emerging distrust in an organic cotton cooperative. Due to many misunderstandings and unclear communication about the principles of the cooperative, some farmers assumed that cooperative employees were involved in corruption. Because of this lack of trust, some farmers decided to not

pay back their debts, which consequently endangered the cooperative's wellbeing (*ibid.*). Maintaining trust seems to be one key factor in the success of a cooperative. In respect of the challenge to establish trust, two factors could influence the formation of a cooperative in Ratanakiri. Democratic politics within the indigenous communities tends to favor the formation of collaborative groups as well as cooperation among groups. This has allowed for the formation of a remarkable conflict resolution system (Ironide, 2013). Also, Ironside (2013) indicated an extraordinary land management organization of communal land, nested within a broader cultural value of sharing. Indigenous people are experiencing economic resilience by supporting one another when some community members are facing hardships. Furthermore, the ceremonies for spirits are an act of collaboration, which is an important institution to maintain life (Ironside, 2013; Bordieu, 2009). Furthermore, farmers practice a labor sharing system.

My research results suggest that these politics within the community are underpinned by a cultural paradigm of prioritizing the value of relationship over the objective target value, and a mindset of constantly being in relation to others. Furthermore, the participating farmers in this collaborative learning process indicated their interest in continuing this process, as they observe the benefits they have from learning and collaborating with each other.

On the other hand, a history of suppression by Khmer leads to repercussions, such as general suspicion and mistrust amongst indigenous communities towards Khmer authorities. Historically, the natives felt the effects of the assimilationist policies of the Sihanouk regime (1954 - 1970), war (1960s - 1975), and the disastrous social experiment of the Khmer Rouge (1970 - 1979). Since Khmer Rouge, indigenous communities "don't want to listen to authorities" (Ironside, 2013: 207). After abolishing the swidden system, social structures are undermined and village leadership has been weakened. This leads to a challenge for new institutions formed to uphold rules within a community, which is tempted to profit from a situation of being ungoverned (*ibid.*). Moreover, farmers were violently forced to work

in collectives during the Khmer Rouge era, which might give rise to negative or even traumatic associations. Other hindering reasons might be the earlier experience with corrupt government representatives. Some participants described how they desperately tried to apply for a certification of the fish sauce they produced. This was hindered by the illegal demand for a hardly affordable amount of money. Therefore, the demand for bribes could become an obstacle to realize legitimization of production, e.g. certification. Another discouraging experience some farmers have gone through is related to the land right politics.

Alternative structures are found in Ratanakiri: One shop was established, which is selling organic vegetables. Initially, it was facilitated by an NGO and is now working independently. Farmers call the shop owner and negotiate a price and a fixed amount before they come to the village. The price is higher than on the market, because customers value the organic quality of the indigenous farmers. This selling opportunity relies on a personal and individual relationship between trader and farmer and can provide a more trustworthy environment.

Tröger and Lelea (2018) explored the relationship of actors involved in Ugandan pineapple value chains. They call for caution in generalizing the often-applied strategy of striking for fairer trade conditions. Moreover, they conclude that socially-embedded intermediaries might actually be important in realizing the crucial role trustworthiness plays in business alliances. This can give rise to social control in the absence of formalized institutions. However, controversial business relationships based on trust can also provoke temptations for short-term gains, meaning “cheating” (*ibid.*). This research finding is possibly transferable to emerging business networks within indigenous communities. For now, I could observe that indigenous people are experiencing discrimination within business relationships, e.g. selling vegetables on the market. Park and Maffi (2017) describe how indigenous women are desperately searching for a place on the local market in Banlung to sell their products. In respect to the superiority-inferiority dynamic between Khmer “teachers” and indigenous people described in this investigation, it is necessary to carefully design value chains by

considering potential trust issues. Empowering could entail finding market niches in which their traditional rice varieties are valued. These value chains would possibly mean empowerment and a way to establish them independently of Khmer authorities.

7.3.4. Innovation – Possible action research design

The recommendation is, to give no recommendation

Ignorance facing complexity

We discuss the possible implementation in a systemic approach and look into the possible trade-offs, which makes it evident that we cannot make any clear statements. Rather we can recognize many open questions. This relates to the voices raised by critical sociologists in the discourse about the role of science in development, who claim that we should assume “uncertainties”, “contradictions” and “emergent properties” arising from the parts (or actors) involved in a system (Morin, 1992). Consequently, avoiding authoritarian recipes imposed by “laboratory science” is recommended (Latour and Woolgar, 1979) by replacing them with participatory paradigm to make room for context dependent knowledge generation (Funtowicz and Ravetz, 1995). In fact, I would claim that in this particular situation it is not wise giving any recommendations about the application of the methods.

Interrelatedness of technological innovations with cultural transformations

To give you my explanation based on the encounters gained in this study, this investigation demonstrated that changes in agricultural systems such as cropping systems are not only having a technological dimension but are also associated with socio-cultural dimensions such as cultural values, distribution principles and different cosmologies. Referring to the body of literature reviewed in the chapter action research this was one of the key driver behind PRA in the late 1980s and onwards. Therefore, adopting new agricultural methods could mean at the same time the need to adopt new dimensions of culture. This is recognized widely in the discourse about socio-cultural influences in respect of gender and power relationships. However,

other more deeply rooted changes should be considered concerning reality assumptions and social behavior induced by adoption. This could be observed in this study, for example by the transformation of distribution principles (sharing towards ownership) and the association of cropping systems with different cosmological spheres. To understand the dimensions of consequences we have to investigate the interpretation by farmers of farming systems and its embeddedness in a web of diverse dimensions. From the conclusion of my results, an innovation is not per se supporting resilience even if it is increasing yields and at the same time is eco-friendly. It could even undermine the resilience of farmer's systems due to the socio-cultural changes associated with it.

Transdisciplinary, action oriented and participative “science with people”

Action research to induce reflecting about influences on socio-cultural dimensions

Bearing in mind this socio-cultural resilience the question of ethical responsibility of an extension actor who is encouraging the adoption of certain innovations becomes pertinent. It seems like the recognition of these factors makes it more complex or even too complex to foresee negative and positive consequences of implementations. Therefore, we should be cautious about encouraging farmers to implement innovations or in trying to calculate their consequences. Drawing conclusions from the investigation, there is an emerging duty of extension actors: It is necessary to aim for examining possible consequences while also considering socio-cultural dimensions and at the same time being aware of the limits to these calculations. As is illustrated in the discussion in the previous chapters about allocation and management, rather than being able to offer conclusive recommendations, we as outsiders/scientists are able to articulate crucial issues and questions that might emerge. For this reason, that there is a danger in implementation programs aiming for large scale adoption of innovations. Although farming systems might be considered as ecological or economical valuable, there will be a lack of time given needed for farmers and extension actors to examine the socio-cultural consequences of the innovation introduction into a new

area. One example given in Ratanakiri for a crop, which seemed to be promising to raise farmers' income, was cashew. However, cashew as elaborated further in section X is undermining the socio-cultural resilience of farmers. Farmers are reflecting over these developments, but it is probably hardly possible to stop the adoption of cashew, as they are still associated with the promises once made, which have not been fulfilled.

Therefore, considering on-farm trials in which not only the ecological but also the economic consequences are taken into account, and also the socio-cultural consequences seems recommendable.

Empowerment for self-determined development

As I have observed in this investigation, farmers are reflecting on these cultural transformations and are attempting to evaluate them. Therefore, involving farmers in the innovation process is not only recommended for the reason of integrating their local knowledge but also to empower them to make decisions over their own cultural transformations. To support the argument for a self-determined development I would first focus on the top-down approach, which showed to be a hindering reason for the adoption in Ratanakiri. This could be related to the discussion about the arbitrary nature of development discourse claimed by a number of authors (e.g. Escobar, 2012) to define the characteristics of the objects to be studied (e.g. the poor, the need for capital accumulation), the concepts to be used (e.g. underdeveloped, sustainable), the theoretical underpinning (e.g. modernization, dependency) and the subjective outlook (e.g. underdeveloped communities are passive, ignorant, powerless). Regarding this situation, extension actors are reproducing power systems. In order to challenge existing power relations, Chambers (1997) claims that we need to revolutionize development paradigms towards a 'radical' participatory systems and flexible projects based on process approaches. This is because participation is conceived to offer the opportunity to embark upon the intellectual process of finding solutions (Ottmann, 2005). Thus, farmers are empowered to decide upon and persuade co-evolution between social and ecological systems (Noorgard and Sikor, 1999).

This would enhance the necessity of facilitating an action research approach in which farmers are encouraged to reflect on not only the

ecological and economic outcomes, but also the socio-cultural, and discuss them in conjunction with each other to find commonly formulated aims.

Shift in research paradigm towards farmers as innovators

An action research approach, which is facilitating a socio-cultural reflection process among farmers, enables researchers to develop an understanding of the negotiation processes within different components of farming systems and the influencing factors as well as different standpoints. Moreover, instead of conducting research about whether farmers take the decision to (or not) implement innovations, research would start with investigating how farmers are developing innovations. This encourages a necessary paradigm shift from perceiving farmers as consumers of innovations towards acknowledging farmers and their potential to develop innovations. In this epistemological approach, the farmer is often perceived in conventional research as a passive element, which is experiencing a conversion into an active subject empowered to articulate needs and demands for research activity (Cuéllar-Padilla and Calle-Collado, 2011). Therefore, farmers need to become involved in the planning and implementation of research activities (*ibid.*). Action research undertaken in this manner would provide the possibility to gain insights into farmers' innovation development processes in order to encourage them. Furthermore, as suggested by Richardson-Ngwenya (2017), research can take a new glimpse and investigate the processes of innovation and adoption at the same time.

Why recommendations are not recommendable under the specific local settings?

In referring to this and the conclusion of the outcomes and discussions presented in this study, especially in the regional conditions of Ratanakiri, aiming for concrete technical advices is not recommendable. There are a number of reasons for this:

The implication of the method implementation and cultural transformation puts outsiders in a position of involvement in complex and vulnerable structures, which are providing resilience.

Furthermore, there is currently a lack of knowledge about methods, which can improve the local context problems farmer are facing and, therefore, experiments need to be conducted.

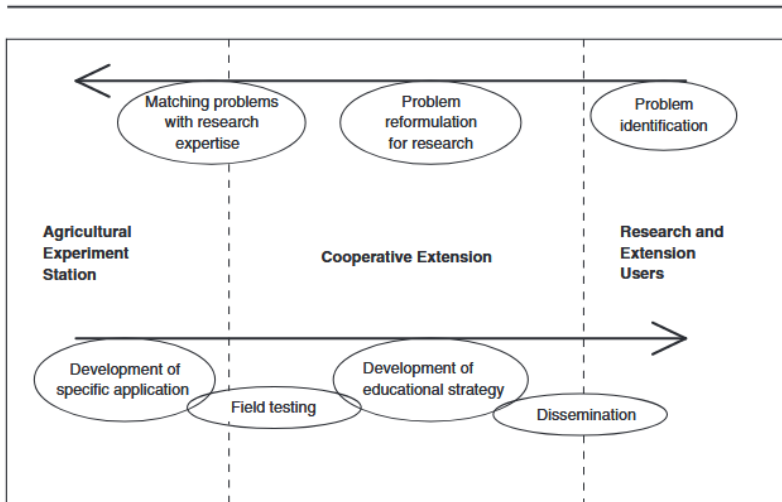
- Extension actors are (in cases where they are not indigenous) missing local knowledge. Due to this knowledge gap, it becomes evident that there is needed research conducted by farmers. This research can only be conducted by indigenous people, due to their local knowledge capacity and, because of an ethical request I would pronounce: Indigenous farmers have the right and need to be empowered within agricultural extension actions to reflect holistic consequences of the implementation of practices, such as possible undermining of the social principles and take and, therefore self-determined decisions on decision upon their cultural adaptation strategies.
- Barriers towards eco-efficient innovation application are derived from the described ‘superiority inferiority’ dynamics between external teachers and farmers, while application are encouraged by indigenous farmers becoming teachers. Consequently, extension actions, which are conducted in terms of a ‘top-down’ recommendation service, are not encouraging solution findings for indigenous farmers and, on the contrary, undermine their capability.
- Technical implementations are also transferring ideas and concepts which might be new to the targeted groups and do not make sense within certain cosmology. A culture-immanent reframing of concepts was shown to be important for the indigenous population, to enable the integration of ideas, which can be regarded as consternating in respect to the traditional cosmology. It is doubtful that outsiders are able to reframe in an appropriate way, as it needs deep insights into the cosmology of others and might be hindered by the assumption of the indigenous people that outsiders are not concerned about spirits.

REFRAMING OF THE TASK AND ROLE OF EXTENSION ACTORS

Based on the above discussion and conclusions a redefinition of the role and tasks of extension actors would provide a higher possibility to encourage farmers to implement or even generate eco-efficient solutions to face their problems.

This redefinition creates a distance from being an adviser who gives concrete technical recommendations. The conventional concept of extension within industrial agriculture is that of transfer of technology from research and development to farmers. Institutional organization and investment in research has been structured, according to this model (Röling, 1988; Röling and Jiggins, 1998). The underlying idea is a model in which scientists are innovating in isolated laboratory conditions, and their knowledge is conveyed in the form of technologies through a pipeline of extension actors to farmers, who are regarded in this model as consumers (Röling and Engel 1991).

Figure 1
**Typical Cooperative Extension Roles in the Research–
 Development–Utilization Process**



Source: Adapted from a University of California Cooperative Extension Training Manual (n.d.)

Figure 13: Warner, Keith Douglass, (2008), Typical Cooperative Extension Roles in the *Research-Development-Utilization Process*. Source: Warner, Keith Douglass (2008).

This model (see Figure 13) of extension is widely criticized by proponents of agroecology, as represented in the “farmer first” discourses (Pretty 1995), who argue for an alternative development model towards a more participatory form of extension (Chambers et al., 1989; Uphoff, 2003), thus challenging the fundamental problem of expert/lay power relationships (Chambers, 1990; Röling and

Wagemakers, 1998; Scoones, 1994). This approach to extension depends on social learning, which Warner (2007) defines as “participation by diverse actors as a group in collective, practical research and knowledge exchange to enhance common resource protection” (Warner, 2007: 757). One example is the model developed by the Department of Communication and Innovation Studies of the Wageningen Agricultural University under the auspices of Engel and Roling (Engel and Salomon, 1997) called “RAAKSHs, which is “... a soft systems methodology to enable stakeholders to engage in meaningful discourse about the social organization of innovation and to design measures to improve it” (Engel, 1995: 1).

Social learning processes

However, participative processes are not an easy undertaking and might involve many discrepancies:

“Participatory approaches should acknowledge both the irreducible plurality of standpoints and the necessity of common existence in order to be a valuable answer to decision making challenges created by the ecological and societal complexity of environmental issues (Van Den Hove, 2006: 3)”.

One way to face trade-offs, different standpoints and the ensuing necessity of negotiations, is instead of promoting a “common goal”, to facilitate an endogenous development by comprising a series of learning processes through negotiation (see Scoones and Thompson, 1994).

In other words, the aim is to foster a dialogue between different types of knowledge (for example scientific, cultural, local and indigenous). This could be called transdisciplinary research and is claimed to be a “true science with people” Funtowicz and Ravetz (1993). True science with people in this respect, is only achieved by joint reflections, which provides the occasion to develop collective solution findings (Funtowicz and Ravetz, 1993), thereby bridging people who are holding different kind of knowledge becomes crucial (Cuellar-Padilla and Calle-Collado, 2011).

How to facilitate social learning process in Ratanakiri?

In the facilitated collaborative learning process, several insights could be gained about how social learning processes could be motivated in the investigated cultural context. As examined in the Chapter X action research and PV were used to empower and encourage learning processes. The results of these showed promise and therefore an application of these tools to induce a solution finding process is recommended.

In order to reframe the extension actors' task, extension actors should be entitled only to facilitate a self-determined solution finding process of indigenous farmers. Furthermore, they can support and encourage the solution finding process by identifying crucial questions. With this awareness, the moderation of the facilitation process can be supported and enable the moderate reflection processes. Thereby, it is a necessary to put a focus on the questions formulated by the targeted group. However, one can contribute by raising awareness of other questions that emerge, thanks to a broader transdisciplinary reflection. The facilitator can become like a bridge between knowledge sources and help to synthesize knowledge. Inspirations could be given by reviewing case examples that are investigating similar problems, inviting other farmers from different parts of the world to share their experience or inviting researchers to support the investigation. The researchers would not come with their own mandate but with the farmers mandate and always conduct research within participative settings in which farmers are the main innovators. This hierarchy ensures that farmers are not becoming research objects but are also entitled to be involved throughout the process research subject. This demonstrates another task of a facilitator, to ensure the role of farmers as the main innovators and the self-determined adaptation-innovation strategy finding.

To summarise, the suggested solution finding process is undertaken in terms of the concept of a transdisciplinary, action oriented and participative research deriving from agroecology.

Some key questions emerging from the discussion, which should be taken into consideration:

Three key questions:

- (1) How to maintain soil fertility?
- (2) How is it feasible and desirable to maintain traditional rice varieties?

(3) How to facilitate a collaborative learning process within which solutions are generated by farmers themselves in synthesis with scientific research?

Identified sub questions based on the discussion can be found in the appendix.

HYPOTHESIS

The suggestion is, as mentioned, action research in which farmers are involved from the beginning with formulating suggestions and designing the research. Subsequently the outlined suggestions are the results of the discussion with farmers. These can be regarded as hypothesis or a starting point for taking action in order to investigate their potential and on-field trials. After discussing them interdisciplinary in a systemic way, we can formulate several sub-questions, which are outlined in the appendix.

To summarize the outlined suggestions:

For the key question (1) How to maintain soil fertility: Indigenous farmers developed the idea of integrated agroforestry system based on agroecological principles. Furthermore, the application of the EM-fertilizer they learnt about in the PV project of this investigation they considered it important to integrate. Criteria need to be developed together with farmers to evaluate the efficiency of methods. In this process, farmers can learn how it is possible to evaluate the increase in fertility. Therefore, it would be necessary to develop tools easy to use for farmers to monitor soil fertility.

For key question (2): How is it feasible and desirable to maintain traditional rice varieties? Building up value chains, which link farmers to customers who value the quality of traditional varieties and organic products, and who are willing to pay a higher price.

For question (3) How to facilitate a collaborative learning process within which solutions are generated by farmers themselves in synthesis with scientific research? Indigenous farmers expressed their appreciation of social learning processes induced in the PV project of this investigation and being motivated to continue exchanging knowledge. Briefly, a participative, action oriented and transdisciplinary research approach discussed in depth in this chapter should be supported with PV and induced with on-farm trials.

POSSIBLE STEPS DISCUSSED WITH FARMERS:

Finding funding and creating a network for collaboration: When I met with farmers to discuss the potential solutions, we were able to collect movies in which farmers expressed their motivations to conduct on-farm trials. The idea is to create a blog, which is a platform on which the participative movies conducted and the messages given by farmers can be shown to an interested audience, which therefore opens an avenue for transdisciplinary discussion and potential inspirations derived from it. Likewise, potential funders or cooperation partners could be found in this way.

Social learning process:

Three villages with farmers who had been participants of the project are eager to conduct on-farm trials and experiments. They are from the three different villages involved in the PV of this thesis and could be regarded as potential model farmers. The on-farm trials would be conducted and inspired by the farmer field-school approach. Although worldwide, the available evidence on the benefits of FFS has been discussed controversially (see, for example Julius et al., 2006; Godtland et al., 2003; Mancini, 2006; Mutandwa and Mpangwa, 2004; Mwagi et al., 2003; Praneetvatakul and Waibel, 2006; Quizon et al., 2001; van den Berg, 2004; and Yamazaki and Resosudarmo, 2006). Based on my results that in this specific local setting it would be an appropriate approach for the above outlined reasons. The key from the encounter was that hands-on experiments are crucial for indigenous farmers in Ratanakiri and the potential of model farmers, which became evident in the PV process.

External knowledge input

Farmers articulated that they would appreciate external input by farmers from other areas of the world who could share their experience. Also, they expressed their appreciation for inspiration by scientists, as well as for the expertise from NGOs holding experience in facilitating cooperatives. The involvement of PDA and other local extension actors has also been considered (already three indigenous organisations articulated their interest in getting involved with the suggested project). Movie showings could offer occasions to open an avenue for discussion with others. In those meetings with extension actors there is a need for facilitation in order to mediate out superiority/inferiority dynamics.

PARTICIPATIVE VIDEO MAKING

Participative video making could be applied to create a platform for knowledge sharing, bridging physical borders. One idea could be an excursion of farmers to other regions to see the application of organic fertilizer or agroforestry, so they could identify practices they would like to apply. Moreover, with participative movies farmers would not have to travel, but could watch movies conducted by farmers from other countries, such as a rice cooperative in Indonesia. Furthermore, farmers could film problems in their own field and afterwards, these movies could be sent to external experts who could give input and ideas to be tried out in experiments. The collaboration with other stakeholders who are following the concept of participative movie making could be fostered to encourage farmer-led experiments and solution findings. One example of a multi-stakeholder platform with a focus on applied co-creation and/or dissemination of knowledge are the “PROmoting Local INNOVation” (PROLINNOVA).

Trust building

One crucial step is required is building trust between the different stakeholders and encouraging farmers to establish reliable communication channels, which are designed to prevent misunderstandings and provide transparency.

8. Conclusion

This study investigated the question: What are in the emic perspective of indigenous small-scale farmers discouraging and encouraging reasons to (not) apply eco-efficient methods?

Seven objectives were formulated to address the research question. These objectives can be positioned on three different levels: (1) On an action-oriented level to support local farmers, (2) on a level of generating transferable knowledge for extension actors and (3) on a theoretical level to contribute to the discourse about influencing factors on adoption. Below is a summary of the achievements of this study in relation to the seven objectives.

(1) Boosting the application of eco-efficient methods through induced learning processes in which farmers learn about eco-efficient methods.

Within the action research undertaken a collective learning process was initiated in which two indigenous farmers who are experienced in applying eco-efficient methods showed their eco-efficient farms as well as other farmers mixed cropping systems. They also demonstrated how to produce and apply organic fertilizer and natural pesticides. In an emerging knowledge sharing process amongst farmers, several farmers decided to become teachers for other farmers in their own and other villages. This was to spread the knowledge gained and to apply the EM-fertilizer and natural pesticides on their fields to conduct self-initiated experiments.

(2) Contribute towards empowering indigenous farmers to become integrated subjects in a discourse surrounding eco-efficient methods. Also, how to solve challenges that they are facing by fostering a dialogue within communities and with local extension agents.

Discussion and reflection processes about current challenges and solutions were encouraged amongst farmers from different communities and between farmers and local extension agents.

In the role of being experts, farmers shared their perspectives about problems they are facing in discussions with extension actors such as local governmental representatives and NGOs. For example, threats to their resilience both in terms of their farming system and more broadly in terms of their health as a consequence of pesticide use. Another threat to resilience voiced by farmers was their need to buy contaminated rice from the market as a result of giving up on growing local rice for subsistence.

(3) Examining participative video making as a tool with which to encourage empowerment and learning processes in respect of eco-efficient methods.

The avenue for a dialogue amongst/between extension actors was granted by a movie event in which a number of different videos filmed by farmers were shown. These films contained messages they wanted to share, recorded problems in their fields, reports on eco-efficient

farming, tutorials for eco-efficient methods and an advertisement movie for an organic fertilizer business idea they developed. Participative video making proved to be a useful tool to overcome the superiority inferiority dynamic observed as a barrier in the communication between extension actors and indigenous farmers and empowered farmers in the role of experts. Likewise, participative video making proved promise in terms of encouraging/stimulating participation and create a fruitful environment for collective learning processes. One needs to reflect critically on the introduction of a technology which is not affordable by indigenous farmers and might create a sense of dependency on foreign investment into participative learning processes.

(4) Exploring different ways in which to conduct extension activities and induce learning processes in a participative way, subsequently setting inspiring impulses for involved agents.

The dialogues and learning processes enabled by the participative action research approach allowed/led the participants to explore alternative ways of extension. Participants and local extension agents said that they were inspired by this experience and articulated their motivation to continue fostering a collective learning process by sharing knowledge and conducting field trials.

(5) Developing a grounded theory which seeks to shed light on the emic reasons why indigenous small-scale farmers are deciding not to apply eco-efficient methods in Ratanakiri so as to develop an understanding of the perception of indigenous people.

Based on this investigation, a multidimensional web of encouraging and discouraging reasons could be identified. In respect to the developed grounded theory it is crucial to understand the cosmological concepts involved in negotiation processes. Farmers act in a culturally conditioned framework that prioritizes (1) the value of relationship(s) over (2) the Objective Target Value. Likewise, success in farming is

determined by a causal relationship, between an individual and powerful spirits. Individual performance cannot outweigh this assumed causality—so no matter how hard an indigenous farmer personally strives for his goals, without an intact relationship to these spirits, any efforts will be futile. Therefore, human agency is less important than the maintenance of a good relationship with spirits. This lowers the interest in eco-efficient methods. However, these convictions are involved in a complex negotiation process in terms of cultural transformation emerging due to recent pressure on indigenous small-scale farmers to adapt. Farmers who adhere to traditional farming methods display the ability to augment and partition their own system of *one single* cosmology into a *set of cosmologies* if adjustment pressure is exerted. In the eyes of the traditional farmers, the Khmer-farming immigrants who operate in a capitalist-based market economy, and who have introduced the so-called Cashew Cropping System into the Ratanakiri region, do not have to fear negative repercussions from deeds that are per se detrimental to spiritual relationships, as they move within a sphere *distinct from* the inherently spiritual one. In similar lines, indigenous farmers act in a distinct cosmological sphere when they are adopting ‘Khmer farming systems’ such as cashew. Indigenous farmers find themselves in complex negotiation processes of different cosmological concepts by being confronted to find new adoption strategies towards recent changes. For example, the fundamental idea of slash and burn cultivation is to leave nature to regenerate in paying respect to spirits. Therefore, regenerating soil with organic fertilizer appears as a new concept.

I observed a superiority / inferiority dynamic between farmers and teachers that tend to permeate these relationships. While, at a superficial level of conversation, indigenous farmers pretend to acknowledge the higher standing of Khmer teachers, they often underhandedly consider them incompetent, as they are no *genuine* farmers, and since they have never implemented the methods taught under real local conditions. This leads into an emerging distrust in methods additional to the fact that This conflicted initial situation of (mis-)communication does not allow for the emergence of mutual respect or appreciation. It eventually culminates in ~~that~~ the methods taught being incoherent with the to-be targeted problems,

complemented by the non-integration of vital knowledge that the native farmers are equipped with.

As encouraging components (to the learning process) indigenous farmers may function in their roles as legitimized teachers as they constitute a credible synthesis of local affiliation and already proven and field-tested eco-efficient methods. If they hand down their knowledge to students, these may—in turn—experience themselves as (now) emancipated innovators who can even-handedly see the effectiveness of what they do differently. The simultaneous nurture of both (1) the earthly soil, and (2) the spiritual realm grants a culture-immanent re-framing process that gradually transforms the strictly cosmologically governed sphere into one that more and more incorporates active human agency. The relationship to actual and tangible soil is at least as vital as the relationship to a cosmological domain. Both require attentiveness and both have to be diligently taken care of in order to produce a positive outcome.

(6)Formulating suggestions for local actors and further research into how the implementation of eco-efficient methods can be boosted in order to support the farmers' resilience.

Due to the observed capability of farmers in the role of teachers it appears to me that regarding farmers as experts, innovators and teachers rather than solely as students to be key element of a successful extension activity in this area. The reasons are the outlined underlying superiority inferiority dynamic, the rich ecological knowledge indigenous farmers hold in this area and the capability of indigenous farmers to re-frame new ideas in terms which are comprehensive within the traditional cosmology. Another reason is the crucial role of farmers in general as innovators and in particular in this area as indigenous farmers need hand-on experiences gained in self-conducted experiments. Acknowledging the discussed socio-cultural underpinnings of agricultural methods and their potential to induce cultural transformation, I perceive it as important to facilitate processes in which farmers are empowered to reflect, discuss and take self-determined decisions for possible transformations. With respect to the extension of eco-efficient methods failing to meet the needs of farmers constraints and perceived threats to their livelihoods and

cultural way of life, there is a need to find alternative ways to facilitate extension. Suggested is an action research approach with transdisciplinary, participative field trials and holistic project to find farm systems including value chains which are evaluating suggestions made by farmers. The project outlined by farmers is aiming for the preservation of traditional rice varieties. In order to achieve this, eco-efficient farming systems need to be innovated such as an agroforestry system in which it is possible to maintain soil fertility. Furthermore, building on the positive experience/outcome of farmers about the organic farm shop initiative, it is suggested to find market niches in which consumers are valuing organic and traditional products to generate economical resilience by diverse income sources.

With regard to the challenge that the meaning of, and need for, eco-efficient innovations might not be comprehensive in emic cosmologies, reframing ethnocentric concepts derived from science into local culture-inherent terms as demonstrated in this research is crucial. An indigenous farmer showed being able to reframe the concepts in an appropriate way. Thus, a lesson to take away for extension actors might be the recognition that members of cultures are crucial to building bridges between cultures.

(7) With the results, contributing to the discourse surrounding barriers to the application of innovations in terms of agroecology.

In order to investigate barriers, it is crucial to shed light on the emic cosmological concepts on which the perception of eco-efficient methods is based. For example I perceive it as important to understand in emic terms human agency in nature and their relationship. Cosmologies are forming the attitude towards adoption of innovations; the self-ascription of being able to solve this problem is shaped by underlying cosmological concepts. However, my research findings also demonstrated that cosmologies are embedded in discourse of transformations in which complex negotiation processes of concepts take place. Individuals find themselves, therefore, in situations of controversy and integrate new ideas based on/within traditional concepts. In respect thereof, it is not advisable to perceive investigated concepts to be permanent and coherent. Moreover, we should investigate the complex web of meanings and tensions experienced by individuals involved in the transformation processes of culture.

Analysing farmers' emic explanation leads me to the conclusion that, instead of searching for causal and logical structures for explaining non-adoption, investigating these tensions between controversy concepts and negotiation processes might enable understanding of the interplay between discouraging and encouraging aspects. Innovation adoption possibly becomes a sensitive topic in this manner, not only in obvious regards, but also in hidden cultural skepticism. This needs to be investigated because it could provide deeper insights into how harmful a method might actually be towards the sociocultural resilience.

Therefore, I would be skeptical towards approaches which are focusing on statistical causal relationships of variables.

The relationship between teacher and students I observed in this study to be important influence factor. Thereby trust building has been shown to be crucial in the competency of the teacher. It might be culturally specific as to which components are important for the evaluation of a teacher as being reliable.

Conclusively, that the results of studies in this discourse do not provide us with complete knowledge, but rather the capacity to be aware of possible challenges and, thus react sensitively towards targeted groups. With this I would like to reiterate that asking questions, rather than assuming knowing, is opening the avenue for dialogue which, in turn, may foster a self-determined innovation process.

Having said this, I would like to release gained insights into a steady process of the negotiation about what reality means.

9. Critical Reflection

If I could start from scratch to write the thesis again, I would definitely change the organization of my writing process. One critical issue for me was that I started working full-time before finishing writing my thesis. This was then a challenge to organize myself on the weekends and evenings to finish writing, and I think it would have been smoother being focused only on the thesis. As my work is very different from theoretical thinking, I enjoyed on the one hand jumping between different worlds but on the other hand it always took some time to get back into it. As I felt more and more committed to the project in the field, I decided to really dive into it. To be able to do, I needed to have income, so it was my compromise. This made the project bigger than it was intended to be (detailed recommendations and amount of data gathered). I was so committed and happy for the chance to get to do such a project that I lost sight of the framework of a Master thesis. The reason might be that I actually planned the continuation of the project while writing up the recommendations. After realizing how many pages had been written, I feel sorry for those who have to read them. Also, I felt unable to shorten it because this would have taken even more time, and at a point where I felt unable to invest more energy parallel to working. This is to learn that I should have set a clearer and more feasible framework for myself. The manuscript for a peer reviewed journal is hopefully giving an audience who is interested but not able to read the whole thesis the chance to get some insights on a short version. However, for my learning experience I don't regret that I got into it in depth because this gave me the insights I was longing for. I am very thankful for those who gave me the opportunity to do so.

With the action research project outcome in general I felt the farmers were satisfied. However, I am sad about the following issue: One lady farmer who was very frustrated that scientists are only extracting data was not coming to the final movie event. I felt frustrated about her non-appearance as her claim was one main driving force to finalize the

videos and organize the meeting for creating a knowledge sharing. It felt like I failed and just confirmed her presumptions and frustration again. Wondering how this could happen I realized how powerful on the one side those presumptions are and how difficult it is to break through them on the other side. I realized how I was playing my part and that it became like this: I should have re-visited her earlier to tell her about the whole idea of the movie event, and integrated her as an official speaker or with a task making her feel ownership of the event. Also, I could have saved time and made the process easier in the field with better technical equipment. It seems maybe not important at first for a research process, but in the field one realizes how unnecessarily time consuming it is to edit movies with a computer overwhelmed by the data, and too few chargers making one get up in the middle of the night to change batteries.

Reflecting the validity of my research results makes me think of the metaphor – understanding of an elephant based on Instructivism, Constructivism and Connectivism like illustrated in Figure 14.

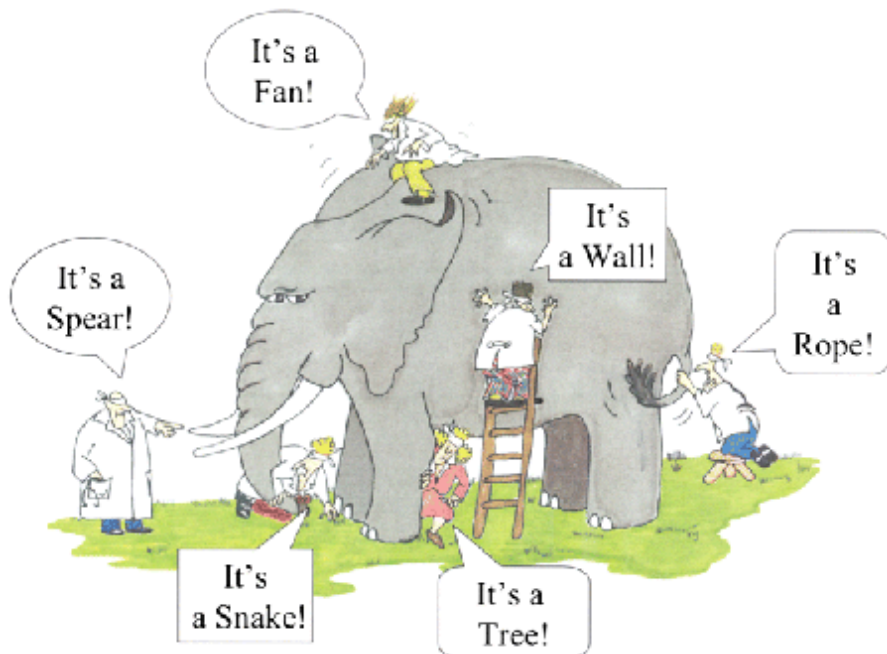


Figure 14: Sui Fai John Mak, (2009), *Methaphor of an elephant* [ONLINE]. Available at: <https://sui fajohnmak.wordpress.com/2009/03/19/learning-metaphor-understanding-of-an-elephant-based-on-instructivism-constructivism-and-connectivism/> [Accessed 22 November 2017].

As much as we try to understand what the elephant is we can only understand aspects and are interpreting it as imaginable within our horizon. Therefore, we are only able to understand and describe aspects. Here communication barriers also come into play: I assume that people are unconsciously trying to full-fill presumed expectations in interaction. For example, I guess that indigenous people are trying to formulate their worldview in a way they assume I would be able to understand. Therefore, my access to their world will always be limited due to me being a stranger. On the other hand, while being strange to what they take for granted I am able to unveil and reflect their incorporated paradigms. Yet only to a certain extent due to my limited access. Another barrier to encounter is that I had to depend on my interpreter's interpretation. As my main interpreter was Khmer, this might have influenced what indigenous people told due to the experienced history of discrimination by Khmer and unacceptance of their traditional beliefs. In fact, when I entered the field with an indigenous translator, ideas about spirits got articulated more in-depth. Realizing the limitation due to my language skills I decided, if I am returning to Ratanakiri I will try to learn some of the indigenous language to build stronger relationships and show appreciation of their cultural identity.

Appendix 1. Eco-efficient methods of the action research project

EM fertilizer

The model farmer introduced decided to teach liquid EM fertilizer to the other farmers and hence it became the eco-efficient method taught within the collaborative learning process of this investigation. To understand this specific eco-efficient method, we shall in this chapter indicate the multidimensional functions of applying EM fertilizer through a literature review of studies conducted on the eco-efficiency of this method. Searching for sustainable ways to increase agricultural productivity Higa (1991) conducted experiments in isolating beneficial microorganisms from the soil. These microorganisms he termed eco-efficient microorganism (EM). EM summarizes a broad variety of around 80 different microorganism species including photosynthetic bacteria, lactic acid bacteria, yeasts, actinomycetes, and fermenting fungi like *Aspergillus* and *Penicillium* are (Higa and Parr, 1994).

Often reported is the increase in crop growth and yield due to the application of EM (Daly and Stewart, 1999; Khaliq et al., 2006; Javaid, 2011; Yan and Xu, 2002). However, in some short-term studies (only one crop growth season) the effect of EM on crop growth, yield or quality was not usually evident (Daiss et al., 2008). Nevertheless if effective microorganisms are applied periodic repeated these possible drawbacks in the first cycle can be overcome (Javaid, 2006).

Javaid observed a gradual increase as subsequent crops are grown (Javaid, 2010). Experiments conducted in different parts of the world on various agricultural crops have shown that the application of beneficial microorganisms improves soil fertility as they are promoting favorable soil physical and chemical properties (*ibid.*). Now, the question is which beneficial functions and symbiotic interactions with plants of EM leads into the increase of crop yields? In order to understand these there is a need to examine the species involved. Mainly involved are photosynthetic bacteria (*Rhodospseudomonas palustris* and *Rhodobacter sphaeroides*), lactobacilli (*Lactobacillus plantarum*, *L. casei*, and *Streptococcus lactis*), yeasts (*Saccharomyces* spp.), and Actinomycetes (*Streptomyces* spp.).

Photosynthetic Bacteria

The photosynthetic bacteria *Rhodospseudomonas palustris* and *Rhodobacter sphaeroides* are regarded as pivotal to EM as they support the activity of other beneficial and indigenous microorganisms such as mycorrhizae in EM.

They are capable of synthesizing useful substances from secretions of plant roots, organic matter, and harmful gases such as hydrogen sulfide, by using sunlight and the heat of soil as sources of energy (Kim et al., 2004). In these synthesis plant growths promoting substances are produced beside others amino acids, polysaccharides, nucleic acids, bioactive substances and sugars (Higa, 2000). The microbes develop metabolites which are absorbed directly by plants (Kim and Lee, 2000; Ranjith et al., 2007).

Lactic Acid Bacteria

Lactic acid bacteria in EM include *Lactobacillus plantarum*, *L. casei*, and *Streptococcus lactis*. Carbohydrates produced by the photosynthetic bacteria or yeasts and sugars are transformed into lactic acid from sugars (Hussain et al., 2002). These Lactic acid have a strong sterilizing effect and suppresses for this reason harmful microorganisms such as *Fusarium* (Higa and Kinjo, 1991). Additionally, these bacteria enhance the fermentation and decomposition of materials such as lignin and cellulose (Gao et al., 2008; Valerio et al., 2008).

Yeasts

Yeast types contained in EM are *Saccharomyces cerevisiae*. Yeasts also synthesize useful substances required for plant growth from amino acids and sugars secreted by photosynthetic bacteria, organic matter, and plant roots (Higa, 2000). Yeast transforms sugars secreted by photosynthetic bacteria, organic matter, and plant roots into bioactive substances such as hormones and enzymes. These bioactive substances are promoting active cell and root division. Secretions of yeast are useful substrates for other microorganisms in EM culture viz. lactic acid bacteria and actinomycetes (Hussain et al. 2002).

Actinomycetes (*Streptomyces* spp.).

Streptomyces, are producing antibiotics that suppress harmful microorganisms and therefore protects plants from soil-borne pathogens, diseases, and insects (Javaid, 2010).

Five different mixtures of EM can be distinguished, whereby the first one is not produced anymore. The predominant species in EM2 is

Streptomyces which suppress harmful microorganisms. It also contains smaller numbers of photosynthetic bacteria, yeast, and molds. In EM3 the main species is photosynthetic bacteria with smaller numbers of yeast and actinomycetes aiming to enhance the growth, yield and quality of crop, and to improve soil physical properties. Aiming to promote availability of nutrients and the decomposition of organic matter and to suppress harmful insects and pathogens EM4 consists predominantly of the lactobacilli with smaller number of photosynthetic bacteria, Streptomyces spp. and yeast (Sajjad et al., 2003).

Natural pesticides

The Food and Agriculture Organization (FAO) (2002:6) has defined pesticide as:

“(…) any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport”.

Biopesticides are considered as a pesticide based on microorganisms or natural products, such as naturally occurring fungi, bacteria and other microorganisms as well as some naturally occurring chemicals, such as plant extracts and pheromones such as (1) Microbial (viral, bacterial and fungal) organisms; (2) Entomophagous nematodes; (3) Plant-derived pesticides (botanicals); (4) Secondary metabolites from micro-organisms (anti-biotics); (5) Insect pheromones applied for mating disruption, monitoring or lure-and-kill strategies; (6) Genes

used to transform crops to express resistance to insect, fungal and viral attacks or to render them tolerant of herbicide application (Copping and Menn, 2000). Van Driesche and Bellows (2009) specified “the use of parasitoids, predators, pathogens, antagonists or competitive populations to suppress a pest population”.

Generally, in comparison to synthetic pesticides, they have little impact on other non-targeted organisms, no harmful residues as they are biodegradable, as well as reduced negative effects on biodiversity (Regnault-Roger, 2012).

In the course of the evolution of plants they acquired characteristics which enabled them to reproduce and defend themselves. Understanding those strategies can help to limit or eradicate bio-aggressors by developing biological based-products, also called biopesticides or biocontrol agents (BCAs).

Botanical insecticides are chemicals derived from plants (El-Wakeil, 2013). As some of the most most deadly, fast acting toxins and potent carcinogens occur naturally one needs to consider them not necessary being less toxic (Regnault-Roger and Philogène, 2008). Four groups of bio-derived chemicals are in commercial use: pyrethrum, rotenone, neem oil, and various essential oils (George et al., 2014). Plant essential oils are a complex mixture of mainly terpenoids, particularly monoterpenes (C10) and sesquiterpenes (C15), and a variety of aromatic phenols, oxides, ethers, alcohols, esters, aldehydes and ketones obtained from non-woody parts of the plant, such as foliage, when steamed or hydrodistilled (Batish et al., 2008). These components have a characteristic aroma, serving as a defense strategy of the plants, particularly against herbivorous insect pests and pathogenic fungi (Langenheim, 1994). The essential oils of aromatic plants have been used since antiquity as antimicrobial/insecticidal agents, and to repel insect or protect stored products (Dorman and Deans, 2000; Isman and Machial, 2006). Recently, they have been investigated as potential candidates against weeds (Singh et al., 2003; Batish, 2008). They constitute an effective alternative to synthetic pesticides without producing as many adverse effects on the environment (Isman, 2000; Isman & Machial, 2006). Essential oils have many advantages: they are easily extractable, ecofriendly as they are biodegradable and are easily catabolized in the environment (Zygadlo and Grosso, 1995), do not persist in soil and water (Misra and Pavlostathis, 1997; Isman, 2000), possess low or no toxicity

against vertebrates (Enan et al., 1998) and play an important role in plant defense against pests (Isman, 2000; Isman and Machial, 2006; Bakkali et al., 2008).

Plant derivatives have long been used in ancient China, Egypt, Greece, and India (Thacker, 2002; Ware, 1883), but in the mid-1930s to 1950s, they were largely replaced by synthetic pesticides. Nevertheless, overzealous use of synthetic insecticides has led to numerous problems including acute and chronic poisoning, destruction of wildlife, disruption of natural biological control and pollination, extensive groundwater contamination and the emergence of resistance to pesticides in pest populations (Forget et al., 1993; National Research Council, 2000; Perry et al., 2013). The realization of these ill-effects on life and life support systems has led to the need for alternatives to synthetic pesticides, and biopesticides represent a potential substitute (Isman, 2006; Bakkali et al., 2008).

System of Rice Intensification (SRI)

The system of rice intensification (SRI) is to be distinguished from conventional rice cultivation. It is a set of practice to manage plants, soil, water and nutrients (Iswandi, 2011). SRI represents an integrated and agro-ecologically responsive, interdisciplinary approach to rice cultivation (Stoop, 2002). According to the SRI International Network and Resource Center (2016) key to SRI are the following four principles:

1. Early, quick and healthy plant establishment
2. Reduced plant density
3. Improved soil conditions through enrichment with organic matter
4. Reduced and controlled water application.

Hence these principles need to be adapted to the local conditions, SRI is not a method, but a modifiable cultivation system. “Adaptations are often undertaken to accommodate changing weather patterns, soil conditions, labor availability, water control, access to organic inputs, and the decision whether to practice fully organic agriculture or not” (SRI International Network and Resources Center, 2016).

Consequently, it is important to understand these components and their interactions, as well as the synergy between the principles of SRI.

Preventing erosion

Using trees, shrubs, and bamboos or palms for controlling erosion is not a new method (Atangana, 2014). Soil erosion is not only a problem in Ratanakiri but worldwide:

“The greatest threat to providing food for a rapidly growing human population is soil erosion” (Pimentel and Kounang, 1998: 1).

Pimentel and Kounang (1998) claims that, worldwide, we are losing soil thirteen to forty times faster than we can renew or sustain it. Wind and rain are the two major threats to soil composition. Exposed soil is most affected and leads to loss of water, soil organic matter, nutrients, biota, and depth of soil. Agroforestry systems contribute to soil erosion control through the effects of canopy cover, litter, ground vegetation, and the soil stabilizing effect of roots (Atangana, 2014). Especially in steep upland, agroforestry is helping the prevention of erosion. Banda et al. (1994) demonstrated this in the steep upland (44% gradient) of Malawi. The study found a reduction in soil loss to 2 tons ha⁻¹ year⁻¹ with an agroforestry component, compared with a loss of 80 tons ha⁻¹ year⁻¹ without agroforestry. Another example for the erosion-preventing effect of agroforestry is given by Paningbatan et al. (1995), who investigated erosion in Philippines. They concluded that cultivating an alley could reduce the soil losses to 5 tons ha⁻¹ in comparison to farmer's practices, under which soil losses has been up to 100 or 200 tons ha⁻¹ year⁻¹ (ibid). A main reason given by Paningbatan et al. (1995) is the improvement of soil structure, which demonstrated higher stability, low detachability, and high infiltration capacity of forest soils in comparison with cultivated soils. This is why mimicking natural forests in home gardens and tree-based systems can improve and maintain soil fertility, as the roots of trees are stabilizing the soil (Atangana, 2014). However, Atangana (2014) stresses that trees do not automatically lead to erosion control, as he emphasizes the importance of chosen management practices and the design of the agroforestry system.

In my proposed project design, different fruit trees are intercropped in a fruit tree area. As you can see on the transect, fruit trees are grown at the edge of slopes similar to a wall. The fruit trees shall be varieties which are already intercropped by the local, small-scale farmers. The fruit trees serve as preventers of soil erosion.

Water erosion can be prevented by growing barrier hedgerows (Kiepe, 1995). Water is an eroding and transporting agent of soil particles and plant nutrients (*ibid.*). Upland areas are especially affected by run-off losses in cases of heavy rain fall in the rainy season (*ibid.*). Therefore, when heavy rainfalls occur, barriers need to prevent losses of nutrients (*ibid.*). The roots of trees can store nutrients and prevent the soil from depletion (*ibid.*). Trees also store water, which can be used to irrigate cropping systems (*ibid.*). Topsoil and subsoil beneath hedgerows demonstrated to have higher water content in comparison to annual cropping areas (*ibid.*). The reason might be an observed increasing amount of macro pores around the hedgerows and the physical barriers. The hedgerows provide a root system and stems, which leads to a higher infiltration (*ibid.*). One possible explanation for the higher infiltration is the improved soil texture by old root channels, an increase in the activity of soil fauna, and higher soil matter content (*ibid.*). One factor which needs to be considered is the spacing between hedgerows. Tight spacing might lead to a decrease in productivity and fungi, while too much space between hedgerows might lead to a decrease in erosion-preventing effects. (Kiepe, 1995). In addition, trees grown in hedgerows and also trees in general have the potential to serve as a windbreak, which prevents wind erosion (Verheij, 2003).

Antangana (2014) perceives it as most important to have the soil covered by a litter layer for reducing soil erosion. This ground cover can prevent rainfall detachment and reduce soil losses. In alley cropping designs, ground cover of the surface soil protects the soil from rainfall detachment and runoff, reducing soil erosion loss (Paningbatan et al. 1995).

A combination of hedgerows and mulch yielded the best results (Kiepe, 1995).

During the dry season, mulch prevents erosion by minimizing evaporation. Selecting suitable tree species is essential for the design of an agroforestry system (Kiepe, 1995).

However, the threat of erosion is not completely eradicated in an agroforestry system. For example, high canopies with large leaves can increase the kinetic energy of raindrops. Raindrops may merge into large drops falling from as high as 30 m (Nair 1993). The large drops can reach a high velocity and cause splash erosion when they impact the soil. However, studies have shown that runoff and soil erosion decrease exponentially with an increase in canopy cover (Bochet and Rubio 2006). The impact of raindrops can effectively be limited using living and dead plant materials (Nair 1993).

Roose and Ndayizigiye (1997) found that leguminous living hedges in the tropical mountains of Rwanda not only reduced soil erosion rates, but also produced 3–8 kg m⁻¹ high quality firewood, provided forage, and restored soil fertility (Atangana, 2014).

There is a lack in research on soil loss in agroforestry systems (Atangana, 2014) and on-site experiments would be a valuable contribution to this research area.

Nutrient cycles

In general trees are improving the soil fertility due to symbiotic fixation of nitrogen, root turnover, nutrient cycling, and increasing formation of organic matter (Atangana, 2014).

The key process of nutrient cycling in agricultural systems could be described in the following steps: The first step is the mineralization of organic matter and the weathering of rocks. Plants uptake the nutrients released in this process. In the process of decomposition, nutrients are again released. As shown in Figure 14, the nutrient cycle in agroforestry ecosystems and agricultural systems differs immensely.

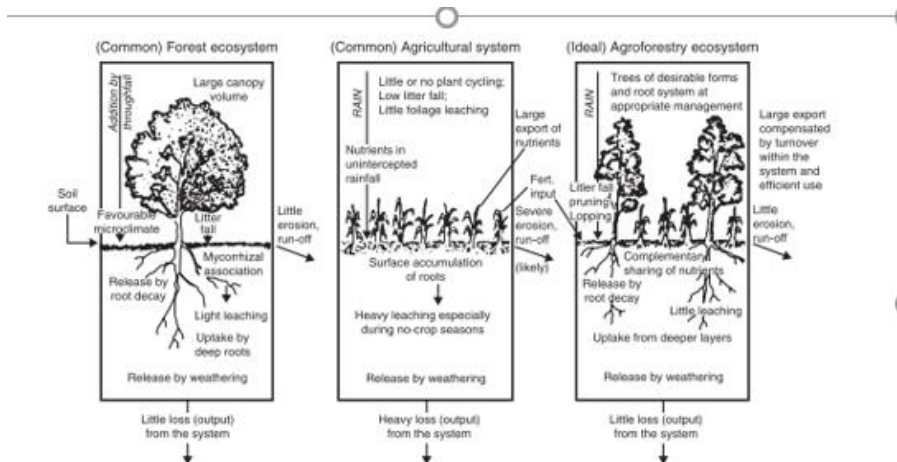


Figure 15: Nair, (1984), *Schematic representation of nutrient relations and advantages of "ideal" agroforestry systems in comparison with common agricultural and forestry systems.* [ONLINE]. Available at: <https://syntheticzero.net/2015/04/21/carbon-sequestration-potential-of-agroforestry-systems-pdf/> [Accessed 31 October 2017].

As illustrated in Figure 15 in agroforestry systems the large export of nutrients is compensated by turnover within the system and efficient use. In agricultural systems, soil needs to be compensated by higher fertilizer input. In the following section, I will outline the meaning of efficient use and the compensating effects.

It is suggested that there is an increased rate of mineralization underneath trees and a greater availability of plant-available nutrients, compared to annual cropping areas (Rhoades, 1995). However, these processes are dependent on the size and age of trees and the site conditions (Belsky et al., 1993; Kater et al., 1992; Rao et al., 1997). For example, lighter soils and less-fertile upland areas favor changes in soil properties (Campbell et al., 1994; Depommier et al., 1992; Rao et al., 1997). The presence of trees in alley cropping systems helps to recycle nutrients, reduce nutrient leaching, stimulate the activities of soil fauna, improve soil fertility, maintain high levels of crop production, and control soil erosion (Kang 1997).

Tree-specific functions which increase the availability of nutrients are:

Nutrients can be absorbed from the subsoil due to the deeper roots of trees, making nutrients available which are typically out of reach for

annual crops. For example, lateral roots of *Acacia seyal* extend up to 26 m and those of *Sclerocarya birrea* extend up to 50 m (Groot and Soumaré, 1995). Néré trees, with crowns of 7-m radius, extend lateral roots up to 20 m from the tree base (Tomlinson et al., 1995). The absorbed nutrients are redistributed by recycling them through litterfall (Buresh and Tian, 1997). Trees demonstrated these functions even after trenching cut off surface lateral roots (Campbell et al., 1994). In Ratanakiri, indigenous farmers in Ratanakiri leave tree alive stems and roots in the soil after cleaning a field for cultivation. As the aforementioned research indicates, this traditional practice could have a valuable function for the soil health in the farming system. Therefore, I suggest integrating this element into the design of the project. Another potential in using deep-rooted tree species is the prevention of nitrate pollution in water supplies (Shepherd et al., 1995). Burning of trees is seen as a means of clearing land in tropical rainforests with little effort, as well as a means of suppressing weeds, ridding the land of most plant diseases, and increasing availability of N and P. However, there is a major loss of C and up to 98% of the N and 40% of the P content of the burned organic matter (*ibid.*).

However, trees are not bringing additional nutrients into the system; they redistribute and recycle nutrients. Nevertheless, the aim is to encourage a closed nutrient cycle in which nutrients are readily available for plants. But it is worth having in mind that by removing crops, nutrients are removed from the system. Not so in a natural ecosystem where the energy losses that occurred are primarily in the form of heat (*ibid.*).

Leaving organic mass, such as pruning and litter, on the fields showed to be promising for recycling nutrients. This leads to the formation of humus and to soil carbon budgets (*ibid.*).

In the decomposition of organic mass, P, K, Ca, and Mg are released (*ibid.*).

Palm (1995) states that several pruning of trees contains sufficient nutrients to meet crops' demands. However, it depends on synchronic crop needs and nutrient availability, which will determine the actual uptake of nutrients. Pruning of trees showed low nutrient-use

efficiency in field trials with agroforestry species: Even when 80% of the nutrients are released during annual crop growth, less than 20% is captured by the crop. Despite Shepherd et al. (1995) concluded that agroforestry systems are only able to reduce nitrogen deficits if a high proportion of biomass is returned to the soil. In a field experiment Shepherd et al. (1995) observed that the soil P stock was not increased in the analyzed dairy-agroforestry system. They suggest adding additional P into the agroforestry system. Moreover, there are differences in the plant species: leguminous materials release nitrogen immediately, unless they contain high levels of lignin or polyphenols. Nonlegumes and litter of both legumes and nonlegumes generally immobilize N initially. These differences need to be taken into consideration while choosing suitable, compatible perennials and annuals.

Leguminous plants have certain advantages. They are able to fix aerially-available nitrogen, thus contributing nitrogen into the farming system.

Hundreds of different nitrogen-fixing leguminous trees are useable for agroforestry systems (Giller, 2011), but not legumes are not the only organisms that are able to fix nitrogen. There are two common symbiotic associations of plants with microorganisms which catalyze nitrogen fixation. Legumes fix nitrogen in association with *Rhizobium*. Non-legume shrubs or trees fix significant amounts of nitrogen in association with *Frankia* (Atangana, 2014). When it comes to leguminous plants, the amount of nitrogen fixed can range from 30 – 500 kg N ha⁻¹ year⁻¹ (Atangana, 2014). Also, Akinnifesi et al. (2010) states that 60 kg of nitrogen can be added to the soil per ha per year through biological nitrogen fixation, and non-organic nitrogen requirements can be reduced by 75%. In addition, agroforestry Rhizorhizal plants (*Rhizobium-legume* symbioses) and Actinorhizal plants (*Frankia-non legume* symbioses), can form hypersymbiotic associations with mycorrhizal fungi: Arbuscular mycorrhizas enhance nutrient uptake, and subsequently improve plant growth (Atangana 2014). Thanks to these associations, the absorption of phosphate, other non-mobile ions, and water is increased, as well as resistance to abiotic and non-biotic threats (*ibid.*). For example, the uptake of P increases due to the hyphen of Mycorrhizas. This is because the hyphen is

increasing the volume of the roots and therefore enabling plants to explore a larger volume of soil for immobile P. As P is the second most important macronutrient in plant growth, this is a meaningful symbiosis (*ibid.*). A review of research that has been done on nitrogen-fixing trees reported that these trees can add more than 60 kg of nitrogen to the soil per ha per year, through biological nitrogen fixation. The research also found that the trees' biomass contribution can reduce non-organic nitrogen requirements by 75 % (Akinnifesi et al., 2010). As species vary in their capability to form these symbiotic relationships it is important to choose suitable trees for the agroforestry system (*ibid.*).

Competition for nutrients between perennials and annual crops

Competition can emerge in agroforestry systems. For example, a negative competitive interaction might be between components water, nutrients, and light (Atangana, 2014). Singh emphasizes the crucial competition for water in semi-arid regions (Singh et al., 1989). This does not tend to present a problem in the wetter parts of the tropics, which is why complex agroforestry systems are primarily found in these regions. Ratanakiri being a place where water and light is plentiful, agroforestry holds promise. Having said that, in discussions about the possibility to conduct intercropping of different tree species or with annuals, farmers articulated the concern that the trees are giving too much shade to plants.

In reporting on my literature review, it is necessary to mention the arguments for and against agroforestry and its purported ability to increase crop yields. One study argues that:

“A major tenet of agroforestry, that trees maintain soil fertility, is based primarily on observations of higher crop yields near trees or where trees were previously grown” (Palm, 1995: 1).

Some argue that the competition between annuals and perennials in a simultaneous system can lead to a decrease in yields (Buresh and Tian,

1997; Kho, 2000; Rao et al., 1997). Nevertheless, crop yield can differ by the distance of annuals from the tree.

Ndoli et al. (2017) found that crop yield was generally reduced more at 1 m than at 3 m from the tree trunk. There is a need to identify solutions to overcome the challenges of below- and above-ground competition (García-Barrios and Ong, 2004).

Atangana (2014: 155) states:

“It would be wise to learn from the experiences of intercropping that is practiced locally to develop or refine an agroforestry system that minimizes any negative interactions that may occur.”

Pest management

Integrated pest management (IPM) seems a suitable framework within the concept of eco-efficiency. IPM and eco-efficiency have the shared aims to increase livelihood income by managing ecosystem services in a sustainable way.

IPM is an ecosystem approach to crop production and protection that combines different management strategies and practices to grow healthy crops and minimize the use of pesticides (FAO, 2016). Furthermore, Abrol and Shankar (2012) point out that integrated pest management strives for preventive methods, which boosts the overall sustainability of agriculture. It is a holistic, knowledge-based approach. The term, ‘integrated,’ thereby stands for taking the interdependencies and interactions of a complicated web of ecological and socio-economic circumstances into account (Grenville-Briggs, 2016).

To illustrate a model of IPM, I use the following reference:

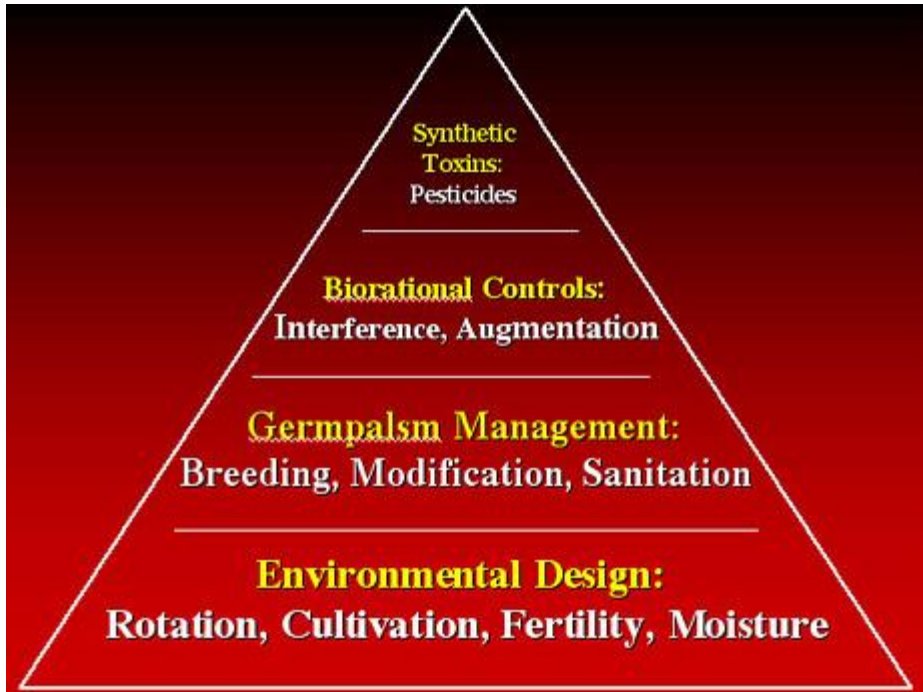


Figure 16: Brian B. McSpadden Gardener, (2002), *IPM-Pyramide* [ONLINE]. Available at: <http://www.apsnet.org/publications/apsnetfeatures/Pages/BioControl.aspx> [Accessed 11 October 2017].

This pyramid demonstrates the different management-levels in IPM: At first pests should be prevented, while treatment with chemicals is the last resort of action (Grenville-Briggs, 2016).

As rice is the prioritized crop within my project design, I will look especially into the IPM strategies suggested for rice, followed by general considerations about pest management in agroforestry systems.

Principles for IPM in Rice

Savary (2012) articulated four principles for Integrated Pest Management in rice fields

First principle: biodiversity

According to this principle, diversity is crucial in IPM strategies. This is promoted by applying the outlined suggestions of agroforestry and the traditional intercropping system.

Second principle: host plant resistance

These strategies are already conducted by farmers as they cultivate locally-adapted varieties on the same field in mixed culture. Furthermore, EM-fertilizer could be applied in the rice fields to increase beneficial microorganisms in order to enhance host plant resistance.

Third principle: landscapes (Savary, 2012)

Eventually the scientific discourse about pesticide application in rice cultivation agrees to what R.A Smith had called a ‘fortunate situation’ of rice farmers: Rice agro-ecosystems are blessed with biotic capable to control pests within tolerable levels. This ecological balance can be threaten by pesticides (Pontius et al., 2002). Matteson (2000) confirms that many IPM specialists regard insecticides as unnecessary in rice fields.

Fourth principle: hierarchies

This principle describes the need to calculate and evaluate trade-offs emerging by applying IPM strategies against each other.

Through the collaborative learning process, it became obvious that farmers have a rich knowledge of fighting pests in a traditional way.

Hence, there is a potential of facilitating knowledge exchange to collect pest management strategies.

Agroforestry and pest management

Based on the above elaborated functions of agroforestry it seems that agroforestry is a suitable pest management strategy, e.g. through strengthened biodiversity and increased soil fertility. However, there are drawbacks regarding pest management in agroforestry systems.

Agroforestry systems can harbor more pests than monocrop systems, according to (Atangana et al., 2014). In Central Indonesia, amplified light availability in agroforestry systems and the improved connectivity between crops and the forests resulted in increased occurrences of parasitism (Klein et al., 2006). In cocoa farms, the shade given by trees favors hosting the fungus *Phytophthora megakarya*, which causes brown rot in cocoa plants. (Atangana et al., 2014) Other pest-promoting effects of agroforestry are humid microclimate; physical protection of mammal and bird pests by the trees; and eventually reduced pest and disease tolerance of competition-stressed crops.

Regarding the multidimensional pest prevention potential of agroforestry, I suggest that it depends on the design of an agroforestry system, if it has either more pest-promoting or pest-preventing effects.

There are various approaches for preventing proliferation of pests in agroforestry systems (Rao et al. 2000). Some of them involve identifying non-host species and using them in an integrated improved fallow, alternating host with non-host plants. Therefore, pest and disease populations experience frequent disturbances, which in turn reduces pest population (Rao et al., 2000). Another potential of the biodiversity given in agroforestry is to identify natural enemies of pests and promote their biological control capabilities (*ibid.*). Parasitic wasps, ants, beetles, birds, rodents, and spiders are able to maintain populations of herbivorous arthropods in natural ecosystems, below the epidemic threshold (Mason 1987; Crawford and Jennings 1989).

Another possibility is to use push-pull strategies by identifying host plants, which are resistant to pests and pathogens:

“Push-pull strategies behavioral manipulation of insect pests and their natural enemies via the integration of stimuli that act to make the protected resource unattractive or unsuitable to the pests (push) while luring them toward an attractive source (pull) from where the pests are subsequently removed” (Cook, 2007).

For example, the push effect can be created by intercropping plants which have repellent or deterrent effects on the target pest. These effects could include reducing the visual prominence of the host plant (Finch and Collier, 2000); repellent or deterrent semiochemicals in the non-hosts; or both (Khan et al., 2000). One example of successful application of this strategy is Molasses grass (*Melinis minutiflora*) and silverleafdesmodium (*Desmodium uncinatum*) for maize in Africa. These grasses release repellent HIPVs (Khan et al., 1997). The pull effect can be created by trap crops (Cook et al., 2006) whereas it is important to consider various factors for a successful application. Some factors include the ratio of the main crop given to the trap crop, its spatial arrangement (i.e., planted as a perimeter or intercropped trap crop), and the colonization habits of the pest (Potting et al., 2005). Therefore, it is important to have a thorough understanding of the pests' behaviour and chemical ecology of the host-pest interactions (Cook, 2007).

Appendix 3: Example transcript of recorded interview

Sarem:#5.08 and OKENDEN supported me by providing training on agriculture such as raising animals and growing vegetables. They sent me to join two study tours, last year they sent me to Koh Kong and Takeo province and this year in February they sent me to Siem Reap and Bonteymeanchey. #5.39

Question: What did you learn from study tour?

Sarem: I went there to see how they grow vegetable and raising animals. For raising animals I learned about raising chicken. For growing vegetable I learned how to grow vegetable and how to produce organic fertilizer. #6.40

Question: can't hear

Sarem: I visited Koh kong they do mixculture such as chilies, eggplants, tomatoes, bitter melon, and many type of vegetables like okra...etc. #7.05

Question: Can't hear.

Sarem: After I visited them I knew and could produce natural fertilizer and some chicken foods that I never known and my growing is well organize than before. Before we growing in our own different way and we saw them grow in other different technique. #7.43

Question: Can't hear.

Sarem: I already grew mixculture such as eggplants, chilies, bitter melon, long bean, pumpkin, luffa gourds, okra and morning glory. I did this after I came back from study visit when I saw them doing that then I applied. #8.05

Question: After you growing vegetable did you see any changing on your life style?

Sarem: Yes, it is changing. When I not yet growing vegetables, I didn't have any harvest and I don't have much money and I started to grow I get some money from it by selling it to Banlung market. My children bring those vegetables to sell in the market which harvest between 2 or 3 days. #10.01

Question: Can't hear.

Sarem: When I joined the study visit I saw them growing by preparing construction to help plants to grow or row, and when I came back I followed only some not all because their vegetable rows they cover with plastic or tents to protect grass to grow, but I don't have it. I just make a row and use nets to cover my vegetable rows which my past experience just used bamboos to build a construction to help the long beans to climb up. So after I saw them doing that, I came back and bought that materials in Banlung market. I just put pole, then I used nets which similar to gill nets, but I used the big hole of nets that use with vegetables cost 15,000 riel for catching one hand size and we can use

in far enough around 60 to 70 meter. This is one point. And secondly, I learned to produce natural fertilizer, one fertilizer name Bokachhi make from husk mix with cow dung which there is two type, burn husk and mix with cow dung, husk without burning (husk I brought from my rice miller) mix with chicken dung, after that mix it well, watering, and keep it 3 weeks before using. #13.43
Question: Can't hear.

Sarem: Last time Etea and Oken came here and taught me to produce liquid fertilizer which make from soil from termites nest and sugar palm. And my experience I learned from study visit from Koh Kong I produced fertilizer from fruits such as pumpkin, banana, and papaya. #14.15

Sarem: The benefit from study visit, after came back I leaned and applied and I received good reward from it. Before ETea and okenden donated me one machine to produce chicken food, and after I came back from study tour I started to grow vegetable and because I don't have palm machine I bought the new machine which need to use petrol and spend much money on it, then I asked some advice from ETEA and Okenden and also I lacked of some resources to produce chicken food, so I took that machine that produce chicken food to use to get water to watering my vegetable. After that I got more and increase my income more. So I get additional money from my growing vegetable that before I grew only cassava. #16.56

Sarem: To talk about my income it increase much approximately 30 to 40% to add on other incomes. Before I grew rice, cassava and cashew, then after study visit I grew mix vegetables such as morning glory, luffa gourds, , bitter melon, egg plants (long egg plants and round egg plants), long bean and okra, last season I grew okra which gave me lots of yield and sold to Banlung market. #17.59

#18.00 #19.16no sound

Sarem: I keep growing other crops and I have new business is growing vegetable. #19.23

Sarem: Increase income because in the past since some NGOs came they train farmers to grow and raise animals. Before I worked in the farm and raise animals, and now I still keeping raising animal and growing vegetable which receiving good income and I tell the true not lie. And I received much money from vegetable even I spent much on it. Before my crops were destroyed by pests, I can earned 100,000 riel per day. #20.02

Sarem: First, in study visit they taught me to produce natural fertilizer, I knew how to use it and motivate me to grow. And secondly, buying vegetable from market is not good it could effect on health problems because we don't know how they grow and use chemical, but when we grow ourselves we know and we don't scare to eat. And it is not mean I don't buy vegetable from the market, sometimes when we celebrate some occasions because our khmer people when having ceremony like eating food from cubage. #20.38

Sarem: It add to all income, I get more from vegetable in one season in last rainy season I got much more money, I received much more from it. And in dry season I get money from cashew, cashew in dry season and vegetable I

receive both in dry and rainy season. Cashew and cassava are seasonal crops that we start to grow from now and harvest in dry season. But vegetable we can harvest every day. #23.05

Sarem: In these few year vegetable are the main income all over other crops that get much more money

#24.23

Question:

Sarem: I started to grow vegetable only two years #24.30

Question: Do you have any suggestion? #28.12

Sarem: For the suggestion what to say about it. I want to say for the community that we want to suggest to other partner NGOs to help us. How to help us? Help us to advertise the real organic market. And want them to help if there is partner NGO to help us for example our shop is small and we want to expand our business, but we don't have much money, we do in a small size if we want to expand it we have no more money. #28.46

Question: What are the benefits of community shop?

Sarem: In general for farmers in and outside community have some benefits from creating community shop. In the beginning some farmers don't like growing or they just grow very little. So when we create this shop, we could motivate them to grow in order to bring their products to sell at that community shop. Some people no need to grow in a big scale for example they grow chilies and basil, they can't eat all in the family, so the remaining they can sell through the network and they can bring it to this shop. The chicken from the community can sell to the shop at a high price than sell to outsider, sell at community shop cost 20,000 riel, and sell to outsider cost only 18,000 riel. So this community shop could help and have more benefit for our farmers. #33.22

Sarem: This market help them to be more confident, when they grow we have the market for them to sell their products. And when they confident, some people started to grow more than before. Some people who never grow for selling, now they know they grow and sell. Sometimes when they can't go to sell at that market, they sell to their neighbors in the village in Lumphat.

#35.35

Sarem: This market motivate them to grow. And they also understood that if they bought the vegetable from the market as in general people now aware of buying vegetable from the market because of lots of using chemical people have a problem with their stomach and intestines which not only older or younger these two kind of sickness is the big concern. #35.58

Question: Can you explain the benefit of using organic fertilizer?

Sarem: The benefit of growing vegetable by using organic fertilizer without using chemical for me it is very important because spend less money. If we use chemical fertilizer we need to spend money to buy it. When we not use chemical fertilizer and use the organic fertilizer that don't spend much money, but spend more labor. We need to use more labor to collect organic fertilizers such as green leaves and other leaves, cow dung, chicken dung, husk, and mix it together. So we don't need to buy because we have our own. That is dry

Kamos. Liquid Kamos I used morning glory and coccinia grandis ក្រូចក្រាវ . I brought morning glory and coccinia gradis cut it into small pieces and mix with sugar and keep it. But I mix the small piece of morning glory and coccinia gradis for one week and after that I mix it with sugar palm. Next I keep it for two weeks, then I can use it. It length 3 weeks equal 20 to 21 days. #41.47

Sarem: Natural way is not spend much money. For example making fertilizer we spend little money to buy only sugar palm. But if we use chemical we need to spend much money on that fertilizer and affect some health problems. So I don't interest to use and cause health problems. #42.07

Sarem: The benefit our soil is not destroyed (Khmer always said spicy soil), using organic or natural fertilizer help to improve the quality of soil fertility which different from using chemical fertilizer that helping only in a short time and after stop using it the soil is destroyed. #42.27

Appendix 4: Example for field notes of group discussion

Ceremony at La En Kren village

Farmer pray to sprit to ask to help him getting better

From his sickness 01 June, 2017

Family members: husband and wife

Position: former village chief

Problem: sick (typhoid and stomachache)

Solving problem:

Met doctor and used lots of medicine. (not well)

Met fortune teller in other village.

Their relative soul want to eat cow at the farm.

If they kill the cow and pray for those spirit, he will heal from his sickness.

Make a ceremony to kill the cow, drink wine to pray to those spirit.

People believe and perception:

Asking few people 11 to 12 people in the ceremony to see their belief and perception:

When people in the village sick, they need to meet with fortune teller.

They listen and apply everything that fortune teller tell

If they said the elder soul need to eat pig, they will kill pig.

If the elder soul need to eat cow, they will kill cow.

If the elder soul need to eat buffalo, they will kill buffalo.

If the elder soul want them to do the ceremony at the farm, they will do at the farm or the house as the fortune teller see and tell.

If they don't follow, they scare bad thing will happen and cause their life.

They do rice ceremony to pray for rice spirit twice or third per rice season depend of the habit of each family did in the previous time.

Each family need to do it as their duty

Their elder do it long time ago as their life routine

They believe the rice spirit will take care their family to have good health

And their rice grow well and get more yield.

They don't confident themselves to make their crops grow well, they depend of the spirit to help them.

If they don't grow rice they don't do the ceremony

If they grow on a small soil, they don't do the ceremony neither

Some people said that

Even do the ceremony but their rice still gave less yield because of the year they grow not good

The landscape they grow on mountain soil, so after two or three years the water flow from the top down and bring the fertilizer.

After two or three years when their rice turn red they thought

Their soil fertility is not good for rice.

They change to grow cashew and cassava.

Because give them more money.

They can sell and have some money to buy rice and some money to buy other things as need.

Buying rice from market is not good, it could cause some health' problem, but they have no choice.

Can't grow rice well.

Change that soil to grow cassava and cashew that believe could earn much than rice.

Decide to buy rice from the market instead.

People doesn't have any solution to solve to improve their soil fertility beside stop growing rice to grow cashew and cassava instead.

Some people have experience on natural fertilizer, but they don't apply because:

Too complicated

Spend more time to produce

Spend more time to wait

Buying chemical fertilizer from the market is fast and easy to use.

Not everyone do the ceremony with cashew or cassava. It is depend on the family who has a strong believe with their rice ceremony and apply with all crops they grow. Some people thought that their old generation use to do the ceremony only on rice farm, so other farm that grow different crops like cashew or cassava no need to apply.

Other assumptions:

1. People love sharing food to each other.
2. People has a strong believe on their ceremony, their praying, and their spirit as a main part of their life.
3. People helping each other by sharing role: male and female.
4. They use lots of plastic bag than their own traditional material such as banana leaves. They influence by Khmer people and use without knowing the effects.
5. They value the chemical fertilizer, if they have money they will use chemical fertilizer as they saw some people already use it.
6. They value cassava and cashew rather than growing rice.
7. They face a problem that no one grow rice in the future next 5 or 10 years if they start to stop growing rice instead of cashew and cassava.
8. People don't like growing vegetables to sell as business because they have sharing food habit from their old generation long time ago, so

they will not get much profit from selling those vegetable to people in the village.

9. Water resource is also a main problem to stop people growing vegetable.
10. People knowing about soil fertility, but no idea to improve it besides changing to grow cashew and cassava and have another idea of using chemical fertilizer.
11. People do not believe that after ceremony they would getting better from their sickness or get more yield, but because they do it long time ago after their old generation, so they can't stop.
 - a. They will sick if they don't do this is the main reason.
12. Fortune teller is the main person who has the power on people.
13. The family who celebrate the ceremony spend much money on that day on:
 - a. Cow
 - b. Ingredients
 - c. Water
 - d. Rice
 - e. Other foods
 - f. Wine...etc.
 - g. It approximately 1,000\$
 - h. Invite nearly all people in the village to come.
 - i. Believe that spend much money on ceremony to fulfill their elder soul need by fortune teller telling would help him heal himself.

Appendix 5: Example for transcript of farmer to farmer -workshop

Part 1

Sokhoeun: First I learned about EM fertilizer that have their ingredients such as sugar palm, soil from termite nest (គ្រាប់ក្រណាត់) bran powder and fresh water, mix them all together then put it cotton tissue and keep it four days, in two days we turn the top down, then next two day we stir sugar palm and mix them with 40litter of water. #1.04 And I am not yet clear how to use it. #1.09

Kham Phoeun: I learned about EM fertilizer. First, we use 2kg of bran powder, soil from termites nest 2kg, and 0.6 g of sugar palm. I don't feel any difficulty. #2.42

Sophep: This morning I learned about EM fertilizer. I have 2 kg of the soil from termite nest, 2 kg of bran powder, 0.6 g of sugar palm, mix it together, and then cover it with cotton tissue. Next two days we turn the top down, then next two days we stir 2kg of sugar palm, after that mix the mixture we keep last 4 days with 40litter of water. #4.29

Question: who went to Laen Chong? What did you learn from La En Chong meeting? #4.55

Answer: I learned remember how to produce EM fertilizer, and I could make it after I came back. And today I have chance to produce it here. #5.40

Farmer Samnang: on 06 May, 2017 I and other farmers from here to learn from farmers in La En Chong about how to produce EM fertilizer and natural pesticide. The natural fertilizer ingredient such as soil from termite nest 1kg, bran powder 1kg, sugar palm 0.3 g, 1 litter of water, mix them together till well mixture, after that cover it with cotton tissue, keep it 2 days and turn the top down. After next two days stir 1kg of sugar palm, mix with 20 litter, then mix the four days mixtures we already make, keep it for 20days, can use it. How to use it?

Improve soil quality we can use 1 litter of EM fertilizer mix with 100litter of water, then water on the soil. #9.34

Use on vegetables: 1litter of EM fertilizer mix with 500litter of water. #9.43

Their benefit:

Spend less, save money.

We get much amount of natural fertilizer.

We can use almost for one year in family use.

We can use on every type of our crops.

Not cause any health problems. #10.15

And he also taught us how to produce natural pesticide. #10.24. The ingredient such as chilies, garlies, and shampoo. #10.32. We make it in the morning and can use it in the evening.#10.40.

Question: So what do you think or do you have any plan after you came back from the meeting?

Answer: When I met them and learned from these technique I thought “it was good”. Then when I came back I wanted to apply because it is natural fertilizer that not cause any health problems. Before I used the chemical fertilizer that made my body smell too bad. After using chemical fertilizer even I had shower, used shampoo to clean it, then when I walked near other people, they still smelt it. So I think it is bad, it is not only cause some problems outside our body, but it will cause some problems inside our body. #11.33.

Question: when did you stop using chemical fertilizer?

Answer: Almost 10 years ago.

Part two

#00-#2.50..... Translation.

Question: today you make new natural pesticide that learn from previous time, so why don't you produce the natural pesticide which learned from La En Chong and make this one instead? #2.58

Answer: It is not difficult to produce the natural fertilizer I have learned from La En Chong, but I learned this one long time ago and I thought this one have the strong quality and strong effect than that one. #3.09.

#3.15- #4.05..... Translation.

Answer: Last time when I joined the meeting at La En Chong I learned to produce EM fertilizer. And today I have chance to produce it at home together with other farmers. First, we have 2 kg of bran powder, 2 kg of soil from termite nest, and 0.6 g of sugar palm mix with two litter of water. After that we cover it with cotton tissue, next keep it for two days and turn the top down. Then next two days stir 2kg of sugar palm, mix with 40litters of water and keep it for 20days and use it. I am happy that I can produce it today. After four days if it have something whiter on their cover, it have a good quality, if it black we can't use it. #6.41.

Question: How do you feel to come and learn here today?

Answer: I just learn today and I am not remember all, but I believe my daughter would remember as she is writing it down. For me if I can produce this natural fertilizer, I can escape from using chemical fertilizer that poison me. #7.28. I grow longan trees that need to use chemical fertilizer. #7.56.

#8.00-#8.40..... Translation.

#8.40-#9.23..... Other talked about the effect of chemical fertilizer on their health and using some treatment.

Answer: Last time I learned to produce EM fertilizer from La En Chong. This morning we mixed 2kg of bran powder, 2kg of soil from termite nest, 0.6g of

sugar palm. After that cover it with cotton tissue, then keep it for 2 days and turn the top down. Next two days stir 2 kg of sugar palm, then mix with 40litter of water and keep for 20 days, we can use it. #10.20

Question: How do you feel after you learned and apply it at home? Are there any benefit from using this natural fertilizer?

Answer: It help me to reduce the using of chemical fertilizer and not cause any health problems. And if it work later on I will stop using chemical fertilizer. #10.47

#11.00-#11.40.....Translation.

Question: after we listened to the group discussion we received 5 points, so what are they? #11.55

Answer:

First EM, so you can draw anything you like to represent about EM. #12.45.

You can draw anything that agree from the group to tell about EM. I can draw this container. #13.00-#13.55.....Drawing.

Secondly, we talked about natural pesticide. So we can draw worm. #14.54

First, you draw about ExM, so how about the morning you learned about EM.

We have soil from termite nest, bran powder, sugar palm, so we can draw termite nest. #17.00

Question: So now we need to discuss one by one. First, we discuss about EM fertilizer. What are the difficulty of producing and using this fertilizer? #17.44. Please everyone has your own idea, what are the difficulty for you to produce and use it?

Answer: I think there is no difficult for me because all the ingredient is easy to find and spend little money. And the use is not difficult too. And we use only soil from termite nest, bran power and sugar palm, so even the poor family could find it easily. #18.56. Then when we already produced it, we can use one litter of this fertilizer mix with 100 litters of water to water our soil. One liter of this fertilizer mix with 500 litters of water to water our crops, beans, spinach, longan, or cashew, we can use on all types of crops. So that is not difficult at all. #19.28. It is different from the chemical fertilizer that buy from the market, it is not difficult, and just we need to have money to buy it. And the difficulty is to earn money to buy chemical fertilizer.

Question from participant: What are the benefit of EM to use on soil or crops?#20.07

Answer: When we water on soil it could improve soil quality, when soil have good quality, then it could grow our crop well. For crops is the same, if we grow spinach without using any fertilizer, our crops grow very slow. Then when we use this fertilizer, it could grow well in 20days. So we can save time, money and not cause any health problem. #21.01

Question from participant: My nephew told me not to use on spinach, if we use it, the spinach will have fruit?#21.12

Answer: That one is the fertilizer to help fruit grow well, for spinach we need their leaves and we use fertilizer to help their leaves grow well. So if you the fertilizer that help the fruit crops grow well on our spinach, it will have

flowers. #21.28. The EM fertilizer I learned from successful farmer from La En Chong, he said we can use on all types of crops such as vegetables and fruit trees. The EXM I produce today, that is for helping crops grow well on their leaves and stems. #21.55. And the next fertilizer I plan to produce later on another day, it would help crops' root and fruits grow well. #22.01

Question from participant: For EXM if we have only 3 types of green leaves, could we make this fertilizer? How many types of green leaves we need to produce EXM fertilizer?

Answer: For the green leaves we have only one type it would be okay.

Question from participant: If one type of green leaves, is there any affected?

Answer: There is no affect if we use only one type of green leaf. Honestly, I don't know too. We need to use few types of green leaves because it might have different vitamin for example calcium, or other vitamin. If doctor they would know in this kind of green leaves have this kind of vitamin...etc. But because we don't know, so we need to use 3 or 4 types of green leaves. We can have 10 or more than 10 of different green leaves, and the important we just need to weigh them all. #23.23.

Question from participant: Do we need to weigh them in the same amount?

Answer: we don't need to weigh each amount of green leaves in the same weigh. We just know if we produce 10litters of EXM fertilizer, how kg of green leaves do we need? #23.42

Question: Do everyone have any other questions to ask about EM fertilizer? Or do you any idea for example " I already learned to produce EM fertilizer, this kind of ingredient would be difficult for me to find, or I am not yet confidence enough to use or to believe that this EM fertilizer has the good quality? #24.17. How about sister from after you have learned, do you think you could apply this EM on your crops or don't want to use it, and why?

Answer: No nothing.

Question from participant: for EM after we produce it and keep it for 20days till can use it. How long could we keep it? #24.50

Answer: We can keep it two or three years. We can smell it, if it smell the same as the first time we use it, so it qualify is still okay. IF the smell change, it is broken. #25.47

Question from participant: If it is out of date, is it harmful to our crops or health when we use it?

Answer: It nothing cause any health problems, but when it is out of that it just not affect to our crops to grow well or to improve our soil quality.

Question: Do you have any difficulty to produce this EM fertilizer?

Answer: For using I think that is not difficult, but I am not yet clear how to produce it in the right way. I'm not yet understand.

Question: So what else do you need to help you? Or any other suggestion to the teacher?

Answer (trainer): Ok! I think you don't have any questions, so could I ask you to make some clarification. #26.47

Do you think all the ingredient is it difficult to find it? No, not difficult because I can find it around my farm. For example: bran power, soil from termite nest...etc. But the difficulty for me how to produce it that I am not yet clear and confidence to produce it on my own. #27.38. But I hope my daughter could understand all.

This EM fertilizer if you want to use it every day can use 1litter of this EM fertilizer mix with 1000litters of water.

One litters of EM fertilizer mix with 500litters of water we use twice per week.

#28.12.

Question: What do we use with 1000litters of water?

Answer: We use it on our vegetables, bean.#28.18.

Question: Can I use every day with my Longan?

Answer from trainer: Longan we don't have time to water it every day.

Answer from participant: Oh! I can mix it in my big container and water it every day. #28.35

Question from trainer: Do you want to water it on their leaves, how do you water your longan?

Answer: I water on the soil?

Trainer: That mean you water soil? So 1litter of EM fertilizer mix with 100 litters of water only. And we don't use it every day. We can do it once for 15 days or one per month. #28.57. Normally, we can use 20days to water our soil. #29.04 You can mix in your big container.

Question: Do you think it is very complicated to use for example using on spinach is different from using on soil or other crops?#30.07

Answer: It is okay I let my daughter write it all down.

Question: How can we notice that our EM fertilizer that we produce have a good quality and we can use it? #31.02

Trainer: It have white thing growing around the mixture and smell good. When you do it, you will understand. For example when we use, we remain some that next will broke, so then we can compare and observe. #32.00

Question: I would like asking you that your daughter will write it down, so could you read?

Answer: Yes, I can. #32.15

Question: Do you any questions please ask the teacher?#32.27 So I would like to know everyone here today want to use this fertilizer or some of you don't want?#32.46

Answer: For me I want to use it every day, but others I don't' know. I use on bean, cucumber, chilies, eggplants and spinach...etc.

Question: So next 20 days you can use it. So when you do some experiment and if it work, you will reduce to use chemical fertilizer or stop use it?#33.17

Answer: Yes, if it work I will reduce or stop using chemical fertilizer because chemical fertilizer cause lots of health problems. #33.37

#33.40-#34.14.....Translation.

Question: How about sister what do you think, is there any difficulty to produce and do you apply it on your farm?

Answer: I think it is not difficult, and I can use on cashew. #35.00

Question: So you have any methods to share to other farmers?#36.38

Answer: When I learned to produce this natural fertilizer I thought it is good. So then I apply it in my village and I want other farmers or other community to produce and use it too. #37.05. It is not difficult to produce it with some simple ingredients such as soil from termite nest, bran powder, and sugar palm. We gain lots of benefits we don't need to use chemical fertilizer, not cause any health problems. So I like sharing this experience to other farmers.#37.38. And we can use it on any types of crops, vegetable and fruit tree.

How to produce it?

Soil from termite nest 1 kg, 1kg of bran powder, 0.3g of sugar palm, and 1 liter of water. We mix water and sugar palm first, then mix them all with soil from termite nest and bran powder. Then cover it with cotton tissue and keep it for two days and turn the top down. Next two days we stir 1kg of sugar palm, and use 1liter of water from 20 liters to mix with the stir sugar. Then mix with 19 liters of water and mix with the mixtures we already make last 4 days, and keep it next 20days, we can use it. #40.08

How to use it?

It is not difficult to use it. Use on crops or vegetable one or twice per week 1 liter of EM fertilizer mix with 500 liters of water. Use every day on vegetable 1 liter of EM fertilizer mix with 1000 liters of water. And to improve land soil 1 liter of EM fertilizer mix with 100 liters of water. #40.05

So it is so easy and not difficult to find the ingredient and not spend much time to produce it only one hour. And use it safely by not causing any health problems, our crops could grow well. So I like sharing this experience about EM fertilizer. #41.21

#41.24....For me come here to learn today because I want to learn about it.

And if some people in my village want to learn I can share my experience to them. #42.09.... #43.20 A farmer and his daughter from Veunsay come to learn this fertilizer because Mr.Samnang brother has some farms near his farm, and he told him about this EM fertilizer, and Mr. Samnang has visited his farm (longan farm) in February this year, so they talked with each other and sharing experience. And Mr. Samnang call him to join the meeting today.

Mr. Samnang also share his book (how to produce EM fertilizer) to him.

Participant: His daughter: my purpose today is to learn how to produce natural fertilizer to use on my cashew. I would like to know how to use on cashew?

Should I water on soil and cashew or just do it on cashew trees? As my experience when I used chemical fertilizer I water only on the cashew trees.

Trainer: For cashew we can water on each tree no need to water on soil. We use on soil when we need to grow spinach or bean, and for cashew just water on their tree is enough. #44.34.And before we grow those vegetables we need to water our soil 7 days before.

Part 5:

Trainer: This is natural pesticide that have some ingredient such as EXM 1litter, 1litter of venega, white wine 1.5 litters, and 1litter and 10litters of water mix together. #1.20. Then we add other ingredient such as chilies, lemon grass, then slice it into small pieces and don't limit their amount, just make sure it sink under 10litters of water not floating . #1.59 We can keep it 10 or 15 days and if we want to use after two days we also can use it. #2.08. We can keep it till next 20days, then we keep take out all the water and keep in the bottles. #2.15.

Participant: Do we need to weigh the green leaves in the same amount?

Trainer: We don't need to weigh it. For example if we use one litter of EXM, we can weigh it 1 kg each such as 1kg, chilies 0.5 kg, tobacco 0.1kg, lemon grass 1kg. You can check in this book. #3.07. Tobacco if we use it much it will be strong and spend much money too. #3.48. It would spend much money on EXM, vinegar, fresh water, it might cost around 30,000 riel to 40,000 riel. #4.13

Participant: Do we need to use fresh water the same as EM fertilizer?

Trainer: We don't need fresh water. We can use the water from the well, keep it few days or we can use rain water, but not the first rain that has Acid. We can use rain water after there have rain few times. #4.46

Question: How to use it? #4.48

Trainer:

1 litter of natural pesticide mix with 1,000 litter of water to use on animals' cage (chicken or duck) or using on vegetable every day.

If we don't have time to do it every day, we can use 1 litter of natural pesticide mix with 500 litter of water using on our crops or animals' cage 4 or 5 days once or once per week. #5.38

We spray it over the chicken or duck' cage to prevent them from some virus or sickness. #5.55.

Question: What are their benefit? #6.03

Trainer: Their benefit:

Our crops is different from before, if we don't use any pesticide, we will get less yield. So we need to use pesticide. We want to stop using chemical pesticide because it cause some health's problems, so we can produce this natural pesticide that can prevent pests and not cause any health problem. #6.38

To produce it is also not difficult.

Participant: How many days we need to keep it before using?

Trainer: Yes, we need to keep if 15 to 20 days. But we need to use, for two days we can use it. #7.07. If we keep it 20days those ingredient rotten, then we take the water to keep in bottles and the mixtures we can take it to put under our fruit trees would be great to help that crops grow well. #7.35

Question: To everyone do think this natural pesticide is too expensive to produce or are there any difficulty to produce it? #8.10

Participant: It is not expensive. If I buy the chemical pesticide from the market, 1 bottle cost 30,000 riel and to destroy only one type of pests.

#8.19. And only 1 liter.

#8.30.....#9.00 Translation.

Participant: How to notice that the natural pesticide we produce has the good quality to use? #9.10

Trainer: We can see white thing on their surface and it smell is good. And their life could be 6 to one year or longer to 2 years. One notice if you use for 6 months, then you need to smell it before using. If it smell the same as the beginning, it quality is good, but if it smell bad and change their color, their quality is worse. #10.12 For example first time its color is likely light coffee, and when it broke the color turn to dark coffee. #10.25 And if it has the same smell and same color from the first time, we can use it. #10.36

Question: Do you use this natural pesticide to cure the problems you face on cassava, cashew or any other problems you face with your crops? #10.53

Trainer: I use it on bean, soy bean, water melon, vegetables and cashew. I don't use on cassava because no pests to destroy it. #11.32 And cassava no need to take care their leaves that different from bean or other vegetable.

Question: Is this natural pesticide could solve your problems with cashew such as termites and stem borer? #11.56

Trainer: No it can't help when pests already come because it is natural it is not strong like chemical fertilizer and even chemical pesticide is also can't destroy pests when it come that I had tried before. #12.10

Question: Do you have any strategies to prevent pests? #12.14

Trainer: For this natural pesticide we need to use before pests come, so it afraid to come.

Question: So please let us know when should the best time to use it with our cashew to prevent pests to come? #12.38

Trainer: When we grow it till one month age that their root is a little bit strong, we can use this pesticide. Be careful not use on cashew that just grow and their root not yet strong enough, it would die. #12.56. When we use our natural pesticide on small growing cashew 1 month age, then there is no pests come.

Question: How long do you use natural pesticide? #13.17

Trainer: We can use one or twice per week till it grow up. #13.24 Or after using one or three times and pests don't come, we can stop for a while, then we can use again next month. #13.34

Question: How do you use on your cashew, on their leaves or their trunks or under the trunk?

Trainer: I use it on their leaves and their trunk because it is small when we use like that it could wet all of the trees. #13.56

#13.56 -#14.40..... Translation.3

Participant: What is the best use one per week or twice per week?

Trainer: If we have time, the best way to use is twice per week. If we don't have time we can use one per week or 10 days, it is depend on you time. #15.0.

Question: Is it the best way to use twice per week?

Trainer: Yes, #15.08

Trainer: One notice as you see it is natural but you can't use as what you want. For example they told "1 liter of this fertilizer mix with 500 liters of water", but you want to use only 1 liter of this fertilizer mix with 100 liters of water, then when using on our crops, it might rotten. #15.30 if using on spinach, their leaves will rotten. If use on cashew, their young leaves will rotten because it is too strong by not following their using method 1 liter mix with 500 liter of water. It is the same as medicine for example doctor let us swallow only one pill of paracetamol, but we take 5 pills, so what happen? (Laughing) #16.04

Participant: some people thought that they don't want to buy tobacco from the market, they want to grow it themselves at home, but it still poison. #16.38

Participant: Even they thought like that it is still wrong. Now they use lots of chemical fertilizer on their crops, so it will spread in the air or in soil, and we need to breath, in the soil when it rain it will flow into water that chemical can't stop their effect after using to cause some health's problems. #17.12

Participant: I poison the chemical that use to color the car (สีรถ) #17.20

Trainer: when I study with successful farmer in La En Chong he said the best water to use is the water from stream, but now I don't want you to use that water. Before we can use that kind of water, but now some poisons from chemical fertilizer used by some farmers will spread in soil, when it rain it would flow to the stream, so you can't use that kind of water. #17.43

Participant: Some minority people now use lots of chemical fertilizer. I and my husband feel scare to use and never use the pesticide that just spray it a few minutes, after that could kill pests, but they are not afraid to use that kind of pesticide without using gloves to protect. #18.18.

Trainer: I'm too scare about it. I am not just to reduce using chemical fertilizer, but I want to stop using it. I use only chemical that destroy grass that I didn't know the best way to destroy it. #18.29 If there is a good way by using natural to destroy grasses I will do it. #18.39

Participant: I and my husband don't use much chemical, only my father use it at his farm, but when we did health checking, we had some problems. The reason because the environment we live in, we need to breath and we get the affect from chemical other people use it on their crops, and also from something we eat. #19.12. For example pokriv (พริก) before I can buy from the market, but now if I don't buy at minority people' farm, I won't. #19.16 Last time I saw they sold pokriv, I asked him where you are from. He said he is from Chres village, If that pokriv come from Oyadav, I won't buy. #19.25 Because Oyadav is near Vietnam border, so I don't buy. #19.30

Question: Does Vietnamese grow this crop?

Participant: Pokriv that grow by minority people is small, but that pokriv from Vietnam is big and white.

Trainer: So that is the reason that you said "using chemical pesticide at least 10 to 15 days before harvest." For you think like that, but some farmers who grow

vegetable, sometimes they use the pesticide today and the harvest tomorrow and sell to the market, that have the strong effect to our health.

#20.16 And they don't care the problems that cause to their customers, they just do something that could give them money. #20.23 And we are the customers, we want to escape from it, but we cannot because we need vegetable to eat, we don't know how they grow, we just buy it. #20.38

Participant: I thought it approximately 80% that farmers using chemical.

Participant: Last time I used chemical pesticide in the morning and in the evening my nephews take it without letting me know (Longan), I was very scare, but they were lucky because they shared to other young boys, if they eat only two people, it will have the problem. #21.04.

Trainer: now it is not difficult, when you learn to produce this natural pesticide before harvest you can use it one or two or three per week, and after you use it a few minutes you can eat that fruits. #21.34

#21.35-#22.38.....

Question: After learning to produce this natural pesticide do you have any difficulty to produce it? Do you want to use it? #22.55

Participant: It is not difficult to find all those ingredients because we can find it in our location. For me I really want to use it, but I am not yet have time to produce it as I have another job. For me personally, I really love to use this natural pesticide because I have face some problems on my cashew, worm eat cashew leaves, and I am not yet have any strategies to destroy it because I don't want to use chemical pesticide. #23.28 I just let them grow by themselves, some trees survive and some died. #23.34 Because I want to use it that is why I asked lots of questions to clarify and apply in the future. #23.43

Question: when do you want to use it as you said you are busy with other job? #23.49

Participant: Yes, my cashew will turn to one year age in July. And I am looking for the best way to use natural pesticide and fertilizer on it. Today is a good opportunity to let me learn, and I hope I could use it on my own cashew. #24.18

Question: how many ha do you have?

Participant: I have two ha of cashew and I thought I could produce this fertilizer and pesticide in June to use on my cashew in July. #24.42

Question: Do you have any difficulty to produce it?

Participant: I commit to produce it because I want to use natural pesticide and fertilizer. As I asked my father that use chemical on his crop (longan) he used chemical fertilizer and pesticide that make from Thailand. #25.12

Trainer: We want to use natural fertilizer or natural pesticide because we want to use it on fruit trees. We eat that fruit too not only selling to the market, so we afraid to cause some health problems to ourselves. #25.27

#25.27 #26.40..... Translation.

#26.40 #27.10.....some young farmers looked hungry so we let them to have a choice that can stay or can go home for lunch.

Question: why don't you want to use chemical fertilizer or chemical pesticide?

Participant: Yes, chemical could cause any health problems. For example my father use lots of chemical he has some problems such as don't have power, don't want to eat and some problems with his liver. So that is the reason that I don't want to use chemical fertilizer and start to think about natural way.

#28.12

#28.20-29.02.....Translation.

Question: Could you please sharing some message to other farmers that you just share us at the moment and the reason that you want to use the natural way?#29.22

Participant: using natural pesticide it is good for our health that not cause any health problems, food, fruits, or vegetable we eat, we don't worry, and don't cause any problems, so we can save some money to spend to cure our health or buying other medicines. We do agriculture because we want money to continue our work, but when we use chemical fertilizer, after we harvest we just spend money to cure our health which don't use that earning to expand our growing or business, no profit. It is very important to have a good health is likely have everything, when we don't have good health is likely have nothing. Like one quote "When you don't have good health, not only 100 riel, even 50 cents you can't earn! When you have good health you can earn from 100 riel and more!" #30.40 There are some effect such as:

Effect to our skin

Effect to our liver. There is antibody is likely a fence to protect our liver, but when this antibody is getting weak, so it can't protect our liver that can cause some sickness related to our liver. #31.15

Question: Why do you want to use natural fertilizer and what are any problems that you face when you use chemical fertilizer? #31.34

Participant: As experience I use both chemical fertilizer and natural fertilizer. I use natural fertilize on soil. I use chemical fertilizer to spray on their leaves which some made in Vietnam and some made in Thailand. When I used it smell too bad and sometimes I didn't feel to eat food. So I thought it affect to my health, so I want to use the natural fertilizer instead this chemical fertilizer. #32.25. Few reasons:

First, my own health

I'm afraid to cause some health problems of my customers.

I always think about it as I know they told chemical pesticide after use need keep 10 days before harvest, and I kept until 15days before harvest and sell to customers. #32.46. I'm very scare of chemical fertilizer or pesticide. If I use this pesticide and it is good effect to my crops, I will stop using chemical. That is what I want. #32.59. Let me do the experiment first, and if we can't stop using chemical we will use in the less amount, we can't say we stop using chemical that afraid we still need to use it. I can't guarantee because I am not yet use this pesticide, let me apply it first. #33.23

My purpose is escaping from using chemical, but I am not sure yet until I see the good result from using natural pesticide and fertilizer. I am not sure yet that I could escape from using chemical. #34.07

Question: how many ha do you grow longan?

Participant: I grow longan on a small area around 0.5ha. I don't have land as before I live in battambang. I just live here only 6years ago. I can't ride motorbike, but I can drive a car. #35.02. I was born in this province, but I left since 1977. My daughter was born in Thailand. Then I

lived in Pailen province. I lived in Pailin almost 10 years, then I moved to Steng treng for 3 years. So when I arrived my hometown I remain a small land from my mother. I am Kreng minority and my wife is Khmer. #37.13

Question: #37.14-#39.14.....Asking other participants to share, but they said others already share.

Question: Thanks everyone. I would like you to see this picture, what do you see in there?

Participant: I saw trees, gauds, pumpkin, corn, eggplants...etc.

Rathana: This picture drew by a lady from Laen kren.explain about the picture in Laen kren. This is what people in La En Kren want to grow in their soil and using natural pesticide and natural fertilizer.#41.00

Question: After seeing this picture, how do you feel? Or do you have any idea? #41.25

Trainer: As I am a son of my parents who are farmers, I learned very little that is the reason that I let my children to study to get the high education. This picture is talking about mix culture, it could prevent pests and soil. Soil is not destroy much if we grow much culture or even pests feel stress that it don't know what to eat and it could improve soil and crops grow well. If we grow cassava this year, next year cassava, so that soil is destroyed. #42.45.

Question: Do you just think about it as you said above or have you done on your soil?

Trainer: I have some land that I do mix culture for example I have 5 ha that I grow cashew, longan, coconut, banana, ក្នុងនេះ មានប្រភេទដំណាំច្រើន មនុស្ស ដឹង ដូច្នោះ ដូច្នោះ ដូច្នោះ ដូច្នោះ ដូច្នោះ so with this area no face any problems that destroy by pests or termites. And the back I grow cashew and Durian that face a problem, termite on my cashew. In fact when we grew by using mix culture, pests not come. But this mix culture we call circle crops that different from cashew and rubbers that we don't need to take it out and grow other crops. #44.10

Cashew and rubber grow only one time and can live long time.

Mix culture grow only 6 months then grow again and again. For example we grow spinach for one month, after harvest we grow spinach again the harvest is less that first time, and third time if grow spinach again, it will give less yield.

That is why they need to do mix culture to improve soil quality. #45.03

#45.05-#46.14..... Translation.

Question: As you said that you grow mix culture on you land in the front area, so do you think you should grow mix culture on your back land that already have only cashew there?

Trainer: I can't do mix culture. It is depend on our land, sometimes we do mix culture we can make more profit, but sometimes not. When I grow cashew I want to make much money from cashew that is reason I grow on a big land

more ha, if we do mix culture we receive only little from cashew, little from other crops, it is not working. In cashew season, if we have only cashew, we can make lots of money from cashew. And the mix culture you see in my front house I don't think I can make money from it, I just grow for family need only. We receive little from this one, little from that one, so we can't sell it. Doing mix culture to feed the family need and growing main crops like cashew to earn big income to support the family. #47.48

Question: How about growing mix culture in a big size? Is it work?

Trainer: It is very difficult, we can't do that.

Participant: Yes, it is difficult and those crops against each other. For example like my longan, if I grow other crops, this longan can't give fruits. It receive less sun light.

Trainer: for small crops we can do mix culture, but for the big crops, big trees are difficult to do mix culture. It competes each other for example grow mango tree and cashew, it will against each other and one grow well, and one don't.

#48.55

#48.58-#50.40.....Translation

Question: Because you not yet experience to do mix culture on you cashew farm, do you think it would work to do mix culture in your cashew farm?

Trainer: I think it can't help because it is a crops that have big trees. If it have pests it can't help.

Question: That is just your belief that never try or do you have any experience on it? #51.43

Trainer: That is what I see the fact even we do the mix culture. In the middle of cashew farm I have mango tree and other trees, but when there are worm, it destroyed my mango. #52.06

Participant: it could help when our cashew is younger and short that we can grow

Trainer: I believe that we can make profit from circle crops for example vegetables that need to do mix culture. And why do we need to do mix culture?

We need to sell to the market, so today we eat this one, tomorrow we eat that one, if we have only one crop we can't make much money. #53.25

#53.25-#57.00.....Translation and producing natural pesticide activity.

Participant: for the big trees we can't not do the mix culture because it will compete each other. So the strong one is grow well and have fruits and the weak one will not grow well and no fruits. So we lost some profit. #58.00 we get one and lost one. #58.29. I think we can grow mix culture in different row that they can meet or touch each other. #58.43

#58.43-#1.12.15..... producing natural pesticide activity.

Appendix 6: Example of transcript of participatory movie

Code	Actors	Description
1:52-2:04	Woman	<p>Part 1</p> <p>I just want to ask you I have worked on my farm land just for three years only but in year 3 my rice growing not good, its leaves looks like red color, why it is like that ?</p>
2:05-3:30	Man	<p>Normally our rice growing good at the first year of farming and after that soil will loss quality so we need to use compost fertilizer one liter liquid fertilizer we use with 200 liters of water and we use for two times 20 days after we plants and when it is 3 months old. Normally we when we see our rice like this we always say the spirit make our rice to get sick but actually it is not, it has disease.</p>
3:35-6:06	Man	<p>Part 2</p> <p>If we have one hectare of land how much we need of this compost?</p> <p>We use one liter of fertilizer with 200liter of water we use it very often like every two weeks</p> <p>We just compare to the humans: If we are sick and we want to become better we don't have energy. It is the same to our crops if we don't add fertilizer it will die.</p> <p>Part 3</p> <p>My rice is growing out of the soil</p> <p>Yeah it is good time for you to use this fertilizer with one liter of the fertilizer with 200 liters of water.</p> <p>We use compost in the morning at 7 am and in the evening or 6pm because it is cold,</p> <p>Do we need to use another new sprayer?</p> <p>When you use a sprayer be sure you didn't use chemicals with it.</p> <p>Part 4</p> <p>Chemicals is not good for our crops even we don't use it in our farm but if someone use it around our farms it will flow to our farm to damage our crops. Sometime our crops dies because we are using too much chemical , you see our rice and cashew trees die.</p>

		<p>Part 5</p> <p>...and we also can see climate change. Generally the rain is not happening in dry season. But now it changed we have the rain in this season. In the past time we had just one or two times raining and it was not much like this.</p> <p>Last year no rain everywhere This year I noted there is much rains it starts to rain from May it is different from last year</p>
6:07-7:20	Man	<p>Part 6</p> <p>Is it okay to use EM-fertilizer with our cashew tree when it was young? Yes you can use it. When we see our cashew this is could be because of it lacks of fertilizer.</p> <p>or because some kind of insects eat its leave. that sometimes we can not see the damage by our eyes so general in the morning when we can see something like a white colour on our crop it is a diseases. We can see it is different when our crops is damaged by the disease it is different.</p> <p>It is the same to our baby. We take care of our crops we take care of our baby so we have to observe and treat it on time.</p>
7:22-8:47	Man	<p>Part 7</p> <p>If we use this for our cashew trees and we can also use it for our rice?</p> <p>Yes we can use it for rice as well and we can also use it for other vegetables and crops. And we have to think of its age how old it is. Is it the young or the old crops.</p> <p>We need to use compost one liter liquid fertilizer with 150 liters of water for our crops that are older than 20 days and we use for two times 20 days after we plants and when it has 3 months old.</p> <p>For vegetables like pumpkins we use 500 liters of water with one liter of liquid compost. We cannot use fertilizer for crops when rain is coming.</p> <p>Can we use this fertilizer in the rainy season?</p>

		Yes we can use it in rainy season but we don't use it when the rain is coming so our fertilizer will flow away by the rain. When the rain stops we can use it. It is all for me so I will let other people to ask
9:16-9:22	Woman	<p>Part 8</p> <p>I have some questions to you because you learned more then me. I also know how to do fertilizer but you learned more than me.</p> <p>Why our cashew tree leave are dead this year, do you know the reason? You see its leave it wants to die</p>
9:23-11:09	Man	<p>I don't know too, because I see everywhere this year it happens like this, but based I have learned (participate the training) if we have problem like this we should note on two thinks.</p> <p>One is related to the climate change and the second is related to the quality of soil.</p> <p>Sometimes when the rain is coming all the flowers will fall of the trees. This is for all kind of crops we grow. When the rain comes in the wrong season this is what the flowers makes fall off.</p> <p>I was taught if it first rain came it brings acid so it makes our crops die. So we have to wash it with water. Because of this year we had the rain in the wrong time. This is why some of our crops is dead and why some of our crops flowers is falling of.</p> <p>This fertilizer is also helping our crops. We have to spray the water in our crops. This one can reduce the damage by the rain.</p>
13:00-16:10	Man	<p>Part 9</p> <p>I just wonder I have a farm with cashew trees the farms around my farm they also grow cashew trees I just wonder why the cashew tree has a lot of crops and flowers but for me it is not the same like them.</p> <p>This is because of the seeds you grow.</p> <p>No it is the same seeds like this people. So when I go to the farm I always safe the seeds from the farms who have too many crops. But still I don't have a good harvest. Why is it like that?</p> <p>Sometimes it is because of the seeds for example two farmers have same kind of seeds but me I have</p>

		<p>different seeds. So me have a lot of fruits but they they don't.</p> <p>Like my cashew trees they look like very good trees and when people when to rent for the crops per year it cost like 3000 Dollars but for others they just get 1000dollars per year. But actually the trees have more fruits but mine is not. This is the reasons why I want to ask you.</p> <p>Part 10</p> <p>The reason that our cashew trees don't have much fruit because of some problems like the soil less quality, it is because of kind cashew seeds that we grow., The third because we don't use the fertilizer regulary and we don't know how to produce it. I have learned to solve this issue we need to have ripe banana and jack fruit, pumpkin, we mix them together with sugar palm 3 kg of fruit with 1kg of sugar palm to produce fertilizer. After we use it with one spoon of this fertilizer with 10litre of water. Especially we can use it when our crops start to use flowers. This is just to share what I have learnt but for myself I did not practice it yet. We produce it because we don't want the flowers falling of. We collect all this material to put together after that we put in the yard for 20days of one month.After that we just take one spoon and put it with 10 litres. And also with the papaya fruit it is good to mix. If we have 6kinds of fruits so we have to mix two kilograms of sugar palm. Please make sure to not use sugar because it is also one kind of chemical. Especially when we spread it to the leaves and flower of our crops.</p> <p>For the roots of our crops we use dry compost. The experience in my village: we have problems with our seeds because we did grow all different kinds of cashew seeds. Sometime we forget about the take caring about the leaves and flowers we only take care of the tree but we have to take care of all parts even the roots.</p>
16:22-17:06	Woman	<p>Part 10</p> <p>I am not clear yet how to make compost fertilizer and the materials to produce, please tell it again.</p>

17:08-28:30	Man	<p>Ok, I will describe again, we need to have three kinds of things such as, husk, soil from small hill, and sugar palm, 4 days after we made we have to check again and then we roast 1kg of the sugar palm with 20 liters of water to put in it again but please remember that when we use it if we have 100 liters of water we put it half liter if we use 200 liters of water we put it 1 liter of the liquid compost fertilizer.</p> <p>This fertilizer is very useful for any kinds of crops because it helps our crops to improve the quality of health and quality of soil. We have to use three kinds of compost to improve our vegetables and soil. Don't use chemical for our crops and vegetables it is not good for our crop health and our human health.</p>
30:00-33:07	Man	<p>The reason that your potato of your cassava broken is because insects destroy it in ground and you don't put fertilizer to feed the roots of the cashew trees and one kinds of butterfly it is yellow color it also can make our crops die, and there are some more kinds of insects that make our young fruit and flowers to make them rotten if we have this issues we need to use pesticide.</p> <p>We need materials 'BondolPech" , "Tanerl" leaves and tobacco, chili, we mix these materials and put in jar with water and we take the water from this jar for the pesticide. We collect 1kg per each (what?) Some materials that we use for producing liquid compost fertilizer such as Tanerleave ,and others leaves from forests. We mix all these leave together and we put in big jar with water and keep it for 20 days and we have to stir it every day before we can use it.</p>
33:08- 34:20	Man	<p>We also make pesticide from bamboo shoot, we collect 2kg of bamboo shoot we sharp and put in the water with 4 liters in a jar for 2 nights and we put detergent, we see some kinds of insects can damage of crops so we can use pesticide to chase them away.</p>
34:22-26:30	Man	<p>When you have problem with this please the fertilizer that I told you from the beginning it made from ripe fruits. This fertilizer we must store in clod place not in hot place and keep it ways from children. Some time we will lack of these materials when we need so better we need to do it before we plant rice and others</p>

		crops, it is not problem with keeping it for long time. We use it 1 spoon with 10 liters of water.
36:52-38:35	Man	It doesn't matter with using it for any kinds of crops and how big our farm is, we can measure how much fertilizer we need to use for your farm. I just want to remind you not just this fertilizer is important to use we have to use three kinds of fertilizers for improving our crops like we have fertilizer we put under ground we call dry compost, (do you have for sale this fertilizer?) I did , I sold to my villagers and when we joined exhibition we brought 10 liters of our liquid compost ten thousand riel/liter, we sold the all at that time, but this year I made only 3 liters. (Woman said: I worry I will forget..), (Man..) if you will forget just write down what I am telling you and copy my phone number and call me when you need to ask me if you forget it.
38:36-39:13	Woman	I wonder why rambutan doesn't have flower or because I don't cut the grass around? And my its flowers fall off.
39:14-40:10	Man	I meet same problem to you as well, based on what I have learned it is because it have not enough water and the first rain in earl year also can damage our crop flower as well, I have this experience too my rambutan had much fruits and my children wanted to pick them up for selling at market and for eating but I said wait they are not ripe enough yet at that time the rain was coming for two days and two nights after the rain stops all the fruits were rotten we could eat them.
40:20-42:00	Man	We have difficulty to grow rambutan and durian because they need much water, in short now a days we have much difficulty for growing crops because of people are using much chemical, the chemical is very dangerous for crops' health and for our health even they don't use in our farms but it comes through the wind to our farms. But what we can do is try to use the fertilizers that I have explained you from the beginning every often like every week or one time in two months.
43:06-44:00	Man	I told you already about this fertilizer, we use it for our crops and our rice it was 15 or 20 days after we grew and we use it again when our rice starts to have flowers and seeds and we must make space between each hole when we grow.

44:02-44:08	Woman	I want to you about how to take care your chickens how do you do? Why your chickens alive without dead?
44:09-46:45	Man	Based on my experience when my chickens have eggs and then it has babies, we have to separate between eggs and its babies, it means that we take out the eggs from its coop we don't let the hens knows we take its eggs from its coop we just keep just one or two eggs there so that hens will continue give its eggs every day but the eggs we take from its coop we put in other coops for others hens bends over the eggs for giving births to chickens babies , so it means that we set roles for the hens on giving eggs and giving birth to chickens babies.
46:50-49:24	Man	We also use this fertilizer for our chickens as well, if our chickens are three months old we use only one spoon of this fertilizer of one liter of water or two liters of water with this fertilizer per day. It is not like chickens we buy from markets , the chickens we buy from market because it fertilizer is not chemical. If we use this fertilizer it protect them from disease and we take care of our chickens carefully like we take care of our heath too.
49:25-50:40	Man	When our chickens are bigger enough we must to produce somethings like medicine to prevents them from any kinds of disease, we need ginger, garlic, sugar palm we mix them together , we need to have 3g of ginger, 1g garlic, and 4g of sugar palm after 15 or 20 days we take the water from it to using for the chickens but don't use it too much for one chicken
50:55-51:20	Man	I have a question to you. Why our cashew tree can be destroyed by termites? How to solve this problems?
51:22-52:26	Man	I used to use chemical as well sometimes, I buy from market we called EM 2014, but based I have learned if we termites try to destroy our cashew trees we have use ashes to put in our cashew trees every morning so they will stop destroying it.
52:27-52:	Man	I have second question, why some of our cashew trees appear latex when it has this it will die, why and how to solve?
52:45-56:52	Man	This is generally happen everywhere so we must use our pesticide on our crops, these disease happen because some kinds of insects on our cashew trees like worms and this kinds of worms become from some of butterflies and why our cashew leaves and

		<p>flowers dies because of some of insects make it happen so we have to use this pesticide every often to make them go away from our crops but if we still cannot solve it we have to use EM 2014 fertilizer from market because many peoples in other countries use it as well like in Kokea, Japan, France, but it expensive and EM 2014 is not chemical fertilizer ,it can make all kinds of insects to go away from our crops if our natural fertilizer cannot do, we use it every 2 or 3 days, the insect still can eat our crop leaves this mean our crop has no chemical ,</p> <p>peoples who know the vegetables has chemical or not when you go to market you can see the difference , the one has chemical is very good one but the one has no chemical is not do good one. Vegetables fruits from market because they use chemical and it will have bad impacts to our health so we must grow our crops and vegetable by ourselves we buy vegetables from market same to we buy sickness.</p>
56:53-57:04	Man	What materials need to be used to produce the pesticide ?
57:05-59:00	Man	We need to have some materials to produce pesticide such as manioe, ginger, bondopech, lemon grass, chili, Tanerl leave and some we also put detergent, and other plants and put them in one place the jar, if we use 1kg of each we must put 5 liters of water and keep it for 20 days before we can use it and we also can add some material such as chickens shit cow shit.
59:00-59:15	Man	This is pesticide , but what materials to produce fertilizer for improving crops' fruits?
59:15-1:00:54	Man	We use Tanerl leave, husk, or ashes, pumpkin leave, gourd leave, cow shit and chicken shit and we put in jar with water, this we called liquid compost and we use it for one week a tiem.
1:00:55-1:01:15	Man	How to take care your chickens? You told already about but my child was crying at that time so I did not hear you. Can you explain again? And why the baby inside the egg dead?
1:01:16-1:01:50	Man	This issue always happen because of the hens have not enough food to eat, or we don't move the eggs in coop while the hens giving eggs and too many cocks for one hen and some time there too many hens but lack of cocks, generally we have to organize 10 hens

		and only three cocks in same place so the eggs will be good quality.
1:01:51-1:04:10	Man	<p>We have to be careful to care of our chickens, it need sun shine as well same to we need, we have to clean the coops every often to make sure it is clean all days and we have to feed them with enough food so they will be healthy and we also can buy food from market as well to feed them beside the food we make by ourselves.</p> <p>The food for feeding chickens we can do but we just need materials such as corn, rice, and fish cabbage we mix them together to feed them.</p>
1:04:12-1:05:05	Man	This is just from what I learned, but if in your village you form up a group with ten or twenty peoples to raise chickens so maybe some organizations are interested to support you so you will learn all the steps of making fertilizer and how to raise chickens
1:05:54-END	Man	<p>To make pesticide we can practice by different ways, we make our land clear make sure our soil has no worms under the ground, we must take of our crops after we water on them every day. And we also can make compost to prevent from insects as well so we need to have some kinds of biter leaves like Bondolpech and others from forest to produce this kind of pesticide. We use this compost fertilizer for all kinds of crops and vegetables, we spread on our crops'leave and this also can be protected from falling flowers and fruit from its trees. The vegetables and crops are same to human, they need to have food to save their energy like we eat food for our energy as well.</p>

Appendix 7: Example transcript of farmer to farmer teaching

#00-#3.05..... Speaking Tumpoun.

Trainer: stir the sugar palm till it becomes red, then put a little amount in the water to test it, if it turn hard and can break it, it will ready. #3.14 If it is not well cook, it will not turn hard and easy to break. #3.25

#3.25-#4.30..... speaking tumpoun.

Trainer: Next time you can teach to other farmers, or outside your village, just make sure you understand the process to produce it. #4.36

#4.38.....#6.00..... other conversation.

Question: Could you please explain what are you doing right now? #6.06

Trainer:

First, when we stir the sugar palm be careful that not let it turn black.

Test it, when well cook we can test little in the water, if it hard and can easily break, it is okay.

Take 1 litter of water from 20 litters of water to put in this stir sugar and mix it together.

After that we put it in 19 litter of water in the container. #6.37

#6.37-9.00..... Translation.

Trainer:

Then we mix the mixture we already made 4 days in the container.

Keep it for 20days in a dry and cold place.

And keep it away from aunts by using ash or water around the container. #9.29

Participant: Can we cover it with cover container?

Trainer: Yes, we can and need to often open it, morning or evening. Good way we can cover it with tissue or Kroma (Khmer scarf), so no need to open it every day. #9.58

Question: how long can we keep it?#10.03

Trainer: If we make it more, we can use 3 to 4 years as long as good. Keep it in cold place. Dry or liquid kampos if we keep longer, it will broke, but this one keep as long as good. #10.14. Last year I produced 40litters of this EM fertilizer, I can use almost two years. #10.31.

#10.32-#13.55..... other conversation.

Trainer: After 20days we take only water to keep in bottles. And the remaining mixture we can use on our vegetables or dry kampos. #14.08

#14.08-#15.20..... other conversation.

Trainer: If we keep 2 or 3 years it color will turn very red. #15.23

#15.24-#18.23..... testing the stir sugar and add 1 litter of water in.

Trainer: This EM fertilizer to help to improve soil quality after using chemical fertilizer by using 2 or 3 years their quality become good and have rain worms back. IT is very useful. #18.52

#18.53-#19.35..... talking about natural pesticide.

#19.35-#20.00..... Translation.

#20.00-#22.14..... other conversation and translation.

Trainer: Last time people make natural fertilizer from our urine, but now they don't do that because they afraid of those people' urine has cirrhosis sickness.

#22.21

#22.22-#26.41.....other conversation. (To produce fish sauce)

#26.41#27.40..... Speak tumpoun.

Question: Why do you do mix culture in you vegetable garden? What are the benefits? #27.56

Trainer: I do mix culture to prevent pests come to destroy my crops.

For example I grow spinach, then next time I grow chilies, long beans...etc. If we grow same crops, pests will stay there and increase their amount.

#28.45.That is the first reason.

Secondly, if we grow on a small land, today we want to eat cucumber, tomorrow we want to eat eggplants...etc. #29.18

#29.20-#29.35..... Translation.

Question: explain the mix culture to participants. #30.18

Question: How about Kroch village, how do you grow?

Answer: In my village we can grow green bean the same crops every year, it doesn't matter. But it would be difficult for cassava and peanut, for example if we grow peanut this year, we won't grow it next year that need to change.

#30.50. Cassava we can grow only 3 years, can't do longer than that. And a

good way we should grow only one year and change another crops next year.

#30.49. Vegetable is also the same for example spinach, after harvest spinach, then grow spinach again, it will not grow well, and we need to grow another crop instead. #31.08.

Participant from La En Kren: Oh! I grow cassava almost two years, so next year I will grow rice. #31.15

Participant from Kroch: If we plan cassava first or second we receive 10 tons, but in third year we will receive only. #31.24

Question: So after growing cassava, what is the best crop should we grow? #31.28

Trainer: we can grow peanut or soy bean because those crops have more fertilizer. #31.37

Participant Kroch: cassava take a lot of fertilizer from soil, so we can use EM fertilizer to improve our soil quality. For soil that can't grow cassava well, it can't grow another crops too that need to work to improve that soil one or two years later. #31.59

#32.00-#33.30..... producing EM.

#33.30-#33.55..... Other conversation.

Question: Is there is a black thing cover on the mixtures, is it work? And why?#34.00

Trainer: Yes, there is black thing on the mixtures the same as this white thing. It is black because we make not follow the guideline, so through it away and make it again. #34.21

#34.22-#36.08..... making EM.

Question: Do you know now people using this kind of natural fertilizer or keep using chemical fertilizer?

Trainer: In my village people don't use chemical and they also don't use any natural fertilizers. They grow depending on nature, if it is good, they will get it. If it is not good, they won't take it. #36.28. Some people asking to buy from me, if people in the village, I will sell 1 litter of EM cost 5,000 riel. If people from outside I will sell 1litter of EM cost 10,000 riel.#36.48

Question: Do you produce it to sell?

Trainer: Oh no! I don't produce it to sell, but if they want to buy from me, I will sell. #37.00

Question: So why don't you produce to sell?

Trainer: I don't have time. I am so busy. #37.14

#37.14-#39.09..... other discussion (minority drinking culture)

Question: how to open the cover container of this EM fertilizer? #39.17

Trainer: open it a little and cover it every day. If open it longer, it will have something outside to get in, it can break our EM quality. #39.36

Question: If ants touch this EM what would happen? #39.47

Trainer: Ants can bring other sickness to destroy this EM quality. #39.54. To protect ants we can use big jar put water in and keep the EM container in it, or use ash around the EM container, ants feel scare of it. #40.10. All of these are the full processes of making EM fertilizer, so you all understand and can produce it by yourself that just need to buy on 1.03 kg of sugar palm. #41.36

Participant: review in the group and ask who still have question to clarify or who can produce it please raise your hand. And check their understanding. #44.35

Trainer: So I think you all could understand and could make it on your own. And you need to be careful if you house have children, please keep away from them. Sometimes they would confuse it could be a water to drink. #44.55. For example I gave much amount to cows and buffalo it died, so I thought human could face the same if drink much. #45.05. I did my own experiment on my two cows, first time the first cow had blood from their bottom, so I let it drink only twice, it can walk and recovery. Then the second cow was sick too, I let them drink more around 1litter of this EM, then it shaken their leg, and die. #45.34.

Trainer: We use on vegetables is okay. For example this evening we use on spinach then we can eat if we clean it before eating because we mix 1 litter of EM with 500litters of water. #46.37

#46.37-#47.50 Translation.

Question: Why do you do mix culture? What are the benefit of doing mix culture? #48.23

Trainer: There are few reasons such as:

To prevent pests come, pests don't want to come when we have more crops. We can eat different vegetables every day.

We can make more money because we can fulfill the need of customers with different choice. #50.34

#50.34-#51.27..... Translation.

Question: In your village in La En Kren do you grow mix culture or you grow in the other way?#51.40

Participant: I grow mix culture that no need to water it. I grow it in rainy season such as cucumber, pumpkin, wax gaud, bean...etc. To tell the true I don't grow vegetable, I come here to learn about EM to cure my pigs. #52.21
#52.21-#52.50..... Translation.

Participant: I don't grow vegetable because I don't have time and I have only husband and wife I don't have any energy to grow vegetable. I have only 2 female pigs that could give 6 to 7 baby pigs each. #53.08

Trainer: Do you have any questions? #53.33

Participants: We don't have any questions. #53.42

Trainer: WE can grow vegetables during rainy season with our rice. But we might face difficulty and no vegetable to eat in October until February, there are two reason to grow vegetable:

First, to feed our family need.

Second, we can earn as addition income to support our family. If we grow more, we will earn more. #54.45

Participant from La En Kren: Yes, of course I learned with agriculture department to grow some vegetables, raising animals and I believe if we follow them we could earn some money. We can raise chicken ...etc. And to grow vegetable we can't eat all, we also can sell to the market. I know that. #55.43

Question: So if like that, why don't you apply as you have learned?#55.47

Participant La En Kren: I can't do that because I have lots of responsible such as: cassava, rice, cashew, pigs, chickens, cows, and I have only 4 members in family, my daughter studies at high school, my grandson is a small kids, and I have only two old people in the family. #56.29.

Participant in Kroch: For me only myself who work in the farm. I work with cashew, cassava, and other fruit trees. So I don't have any power to grow vegetables. I can do it only in rainy season that no need me to water it every day such as long bean, eggplants...etc. #56.56

Participant in La En Kren: my daughter grow vegetable in the early of the years such as pumpkins, wax gaud, cucumber...etc. then when harvest she can't do that because she studies, so we can't sell, we just eat only. #57.36. But we can save some money to buy from market. #57.49

Question: We find out the best day to meet to evaluate after meeting with successful farmer.

Kroch decide to meet them again on the day that produce EM fertilizer in there village, but not yet know the exact time and date. Will follow up later. #59.10
La En Kren, Ming Phes will discuss with ming March to find the available time to meet again and Rathana will follow up with them. #59.36

List of tables

Table 1: Own Collection. Combination of methods in different research periods	64
Table 2: Own Collection, (2017), Overview movie conducted.	98

List of figures

Image 1: Own Collection, (2017), Indigenous farmer from Ratanakiri.	0
Map 1: google maps, (2018), <i>Location of the province Ratanakiri</i> [ONLINE]. Available at: https://goo.gl/maps/rgpLp6Hws252 [Accessed 17 July 2018].	38
Map 2: global watch, (2018), Forest loss in Ratanakiri 2001, 2007 and 2017 [ONLINE]. Available at: http://bit.ly/2BOCZsN [Accessed 30 April 2018].	44
Map 3: Environment Operations Centre, (2018), Economical Corridors Cambodia [ONLINE]. Available at: https://opendevelopmentmekong.net/dataset/?id=economic-corridors-of-cambodia [Accessed 28 April 2018].	45
Figure 1: Own Collection, (2017), Research design.	51
Figure 2: Steps of conducting an action research process. Modified source: Christnick and Kaufmann, 2017	61
Figure 3: Coghlan and Brannick, (2001), Spiral of Action Research Cycles [ONLINE]. Available at: https://www.researchgate.net/figure/Spiral-of-Action-Research-Cycles-Coghlan-and-Brannick-200119-Cycle-2_fig1_26466364 [Accessed 17 July 2018].	63
Figure 4: World Animal Net (WAN), (2012), Problem tree [ONLINE]. Available at: http://worldanimal.net/our-programs/strategic-advocacy-course-new/advocacy-toolkit/31-uncategorised/244-2-causal-mapping-or-problem-tree-analysis [Accessed 26 April 2018].	67
Map 4: Wikipedia, (2008), Map of Ratanakiri Province with districts outlined [ONLINE]. Available at: https://commons.wikimedia.org/wiki/File:Ratanakiri_districts.jpg [Accessed 16 May 2018].	69

Figure 5: Outline of the participative video making process steps.	83
Image 2: Own Collection, (2017), Field visit model farmer and interview	84
Image 3: Own Collection, (2017), Participative observation - field activities.	105
Figure 6: Atta-Krah, (no date), Research objectives and levels of farmer involvement vary in the different types of on-farm research [ONLINE]. Available at: http://www.fao.org/wairdocs/ilri/x5545e/x5545e08.htm [Accessed 16 May 2018].	105
Image 4: Own Collection, (2017), Field book excerpt	114
Image 5: Own Collection, (2017), Field book excerpt.	116
Image 6: Own Collection, (2017), Slash and burn field.	130
Image 7: Own Collection, (2017), Sacrifice ceremony.	134
Image 8: Own Collection, (2017), natural pesticide production.	135
Image 9: Own Collection, (2017), Often cows had been exchanged against motorbikes.	140
Image 10: Own Collection, (2017), Harvested cashew nuts.	141
Figure 7: Own Collection, (2017), influence of cosmology on adoption.	148
Image 11: Own Collection, (2017), Traditional mix of seeds for intercropping system.	149
Image 13: Own Collection, (2017), Sowing pumpkin seed on ashes.	150
Image 14: Own Collection, (2017), Traditional preparation of the field for rice sowing.	152
Figure 8: Own Collection, (2017), Economical feasibility.	158
Image 15: Own Collection, (2017), Traditional seeds prepared for sowing.	159
Figure 9: Own Collection, (2017), Superiority-inferiority dynamic.	169
Figure 10: Own collection, (2017), <i>didactic (cosmological reframing)</i> .	171
Figure 11: Own Collection, (2017), didactic (technical skills).	174
Figure 12: Own Collection, (2017), <i>Summary of boundaries to adoption of eco-efficient methods.</i>	179
Figure 13: Warner, Keith Douglass, (2008), Typical Cooperative Extension Roles in the <i>Research-Development-Utilization Process</i> . Source: Warner, Keith Douglass (2008).	223
Figure 14: Sui Fai John Mak, (2009), <i>Methaphor of an elephant</i> [ONLINE]. Available at: https://sui fajohnmak.wordpress.com/2009/03/19/learning-metaphor-understanding-of-an-elephant-based-on-instructivism-constructivism-and-connectivism/ [Accessed 22 November 2017].	236
Figure 15: Nair, (1984), <i>Schematic representation of nutrient relations and advantages of "ideal" agroforestry systems in comparision with common agricultural and forestry systems.</i> [ONLINE]. Available	

at: <https://syntheticzero.net/2015/04/21/carbon-sequestration-potential-of-agroforestry-systems-pdf/> [Accessed 31 October 2017].

248

Figure 16: Brian B. McSpadden Gardener, (2002), *IPM-Pyramide* [ONLINE].

Available

at: <http://www.apsnet.org/publications/apsnetfeatures/Pages/BioControl.aspx> [Accessed 11 October 2017].

253

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