Eco-Friendly Intensification and
Climate resilient Agricultural Systems
(DALaM – CIRAD – NUDP)

UPDATE STUDY ON AGRARIAN CHANGES AND THE STATUS OF CONSERVATION AGRICULTURE IN SOUTHERN SAYABOURY PROVINCE

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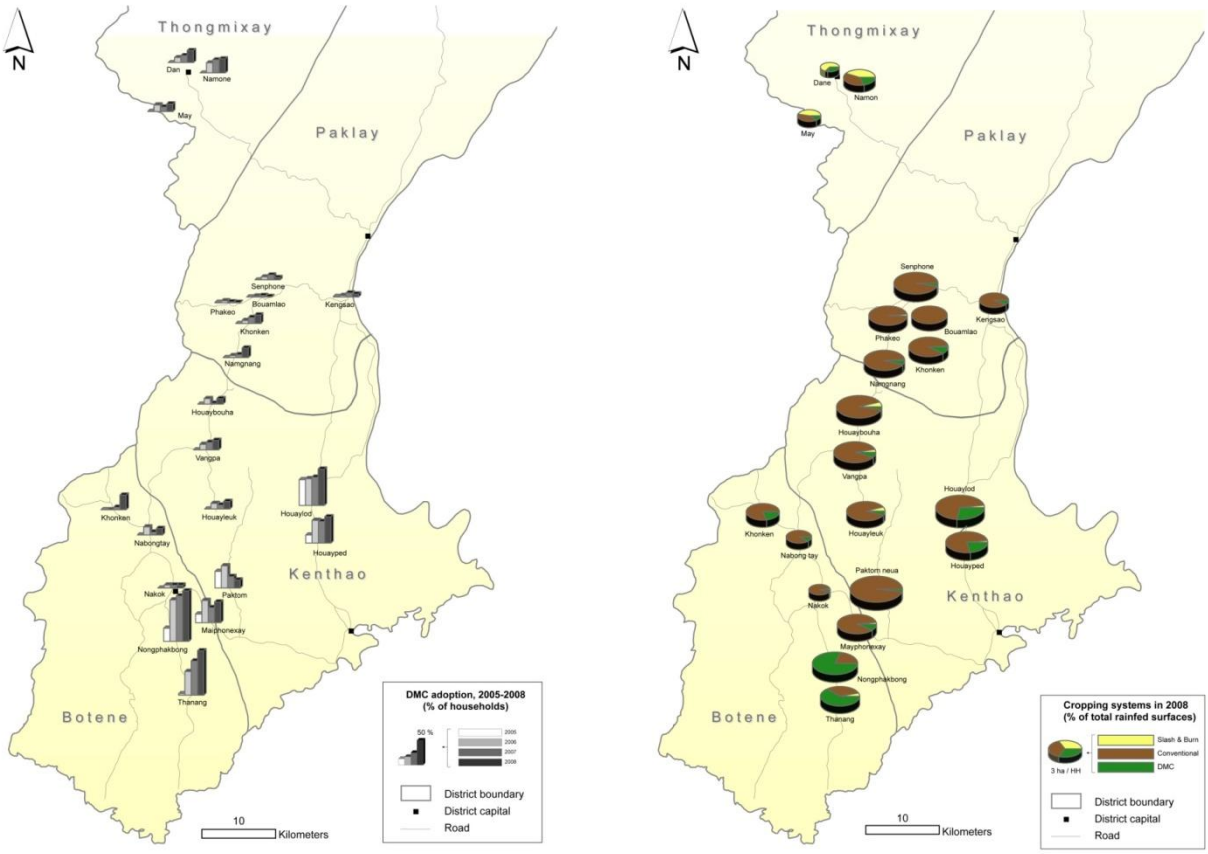
1. Overview of past initiatives related to Conservation Agriculture in Sayaboury Province

1.1. Research-development and dissemination of Conservation Agriculture

Between 2001 and 2009, the four districts of Boten, Kenthao, Paklay and Thongmixay in southern Sayaboury Province have been targeted by two AFD-funded projects dealing with research and extension of Conservation Agriculture (CA), namely the "Programme National Agro-Ecologie" (PRONAE) and the "Programme de Capitalisation en Appui à la Politique de Développement Rural - Point d'Application du Sud de la province de Sayaboury" (PASS). PRONAE was essentially focused on technical research and experimentation on Conservation Agriculture in a few localities while PASS was engaged in the dissemination of the research results among farmers of the four districts. In 2008, PASS had set up CA farmer groups in 44 villages, involving about 1100 households and 1500 ha of land cultivated with direct seeding mulch-based cropping systems. External evaluations showed increasing and fairly high levels of CA adoption in some villages, both in terms of farmers engaged and surface areas cultivated (Figure 1).

At the end of the PASS project in 2009, a Conservation Agriculture Development Fund (CADF) was set up aimed providing a source of funding to continue supporting CA extension and dissemination activities. Since then, the CADF has been supplied by a 10 LAK per kilogram "tax" on the maize sold and exported out of the province. Over the past five years, the Fund has been spent on various initiatives aimed at providing support to traders and farmers associations, capacity building of farmers and district staffs in the field of CA, and promoting contract farming systems for maize-based agri-input supply in 10 districts of Sayaboury Province.

Figure 1. Adoption of Conservation Agriculture in southern Sayaboury Province (Source: Lestrelin et al. 2012)



The cropping systems experimented and disseminated by the PRONAE and PASS projects and the CADF are all gathered under the broad concept of Direct seeding Mulch-based Cropping (DMC) systems. DMC systems are cropping systems that involve no tillage and a permanent plant cover of the soil. The expression 'plant cover' further refers to dead mulch (crop residue, cover plants or dead weeds) or live mulch associated with the crop.

Four main DMC systems have been promoted in the study area:

- DMC maize monocropping (a no-till system with conservation of the residues from the previous season),
- Association of maize and rice-bean (a no-till system where maize is intercropped with rice-bean, cultivated as cash crop for the Thai market),
- Biannual maize–rice-bean rotation (a rotational sequence between maize and rice-bean under a no-till residue management system),
- Association of maize and pigeon pea (a no-till system where maize is intercropped with pigeon pea, cultivated to improve pig feed daily intake).

As pointed out by Lestrelin et al. (2012) however, at the exception of a couple of villages in Boten district that have benefited of a good access to the Thai market throughout the 2000s, adoption by local farmers has generally remained limited to the less complex of these cropping systems, that is DMC maize monocropping.

1.2. Monitoring of livelihood and land use change and CA adoption

Concurrently with the above research and extension activities, efforts have been made to monitor livelihood and land use change and the adoption of CA techniques in the target area. From 2005 to 2008, The PASS project set up its own monitoring system which involved annual questionnaire surveys assessing a diversity of agro-economic variables (e.g. land uses, incomes, farm inputs, etc.) among large household samples (i.e. 2,160 farming households) in 21 villages of the four southern districts of Sayaboury province. In 2006 and 2008, the PRONAE implemented a similar system with more detailed and gender-disaggregated questionnaire surveys (e.g. including variables like education, perceptions, etc.) among 462 households of four villages in Boten, Kenthao and Paklay districts. PASS and PRONAE field measurements and farm monitoring data have also been used for characterizing the economic productivity of CA in comparison to conventional agriculture. Information on farmers' perceptions has been extracted from farmer groups' meeting reports and occasional questionnaire surveys conducted during field demonstrations. A number of reports and scientific publications have been derived from these initiatives (e.g. Tran Quoc et al. 2004; Lestrelin 2006; Slaats and Lestrelin 2009; Lestrelin et al. 2012). Recently, as part of a wider evaluation study on the status of CA in Laos (Coudray and Pillot 2014), seven villages in the four southern districts of Sayaboury Province were revisited to assess the dynamics of adoption, extension or abandonment of CA-based systems and the determinants for these dynamics. More qualitative than the previous initiatives, this study involved mainly key informant interviews, focus group discussions and the collection of statistics on land use and agricultural production at the provincial, district and village levels. Put together, these different studies highlight a broad trend of rapid agrarian transition from shifting cultivation of upland rice to intensive hybrid maize monoculture, followed by increasing land degradation and agricultural and livelihood diversification. They also show that CA adoption dynamics generally follow project intervention, with rapid dissemination rates observed in a number of villages during the full activity of the PRONAE and PASS projects in 2003-2008 and significant abandon rates after the end of the PASS project and until 2012. Finally, they suggest that the dissemination of CA could benefit from awareness raising campaigns among farmers, facilitated access to agricultural machinery and more diversified market opportunities, better structuring of production and service provision activities, and more generally, targeted extension accounting for local agroecological dynamics.

2. Materials and methods

In order to make the most of the historical dataset provided by previous monitoring initiatives and especially allow for robust diachronic comparisons, the choice was make to replicate the approach of the PASS project and conduct questionnaire surveys in the 21 villages monitored between 2005 and 2008 in Boten, Kenthao, Paklay and Thongmixay districts (Table 1). Thirty random household samples were selected in each target village, for a total sample size of 630 interviewees. The questionnaire was kept similar to the one used by PASS – for broad compatibility with the existing database structure – yet it was slightly adapted so as to reflect recent contextual changes and other emerging questions on livelihood and land use changes (e.g. additional questions on land transactions, additional variables related to emerging land uses and income generation activities). Fieldwork and data keying were conducted by a team of CADF officers (3 staffs) and DAFO technicians (3 to 6 staffs) between November 17th and December 25th, 2014.

Table 1.Study villages and samples in the four southern districts of Sayaboury Province

		2014		***2005***	
District	**Village**	**No. households**	**Percent sampled**	***No. households***	***Percent sampled***
Boten	Khonken	108	28%	*106*	*70%*
	Mayphonexay	180	17%	*162*	*60%*
	Nabongtay	58	52%	*56*	*91%*
	Nakok	165	18%	*174*	*58%*
	Nongphakbong	125	24%	*101*	*73%*
	Thanang	82	37%	*76*	*96%*
Kenthao	Houaybouha	300	10%	*265*	*50%*
	Houayleuk	312	10%	*312*	*46%*
	Houaylod	240	13%	*169*	*53%*
	Houayped	215	14%	*189*	*58%*
	Paktom *	399	8%	*131*	*69%*
	Vangpa	358	8%	*260*	*51%*
Paklay	Bouamlao	491	6%	*383*	*40%*
	Kengsao	161	19%	*134*	*67%*
	Khonken	252	12%	*241*	*56%*
	Namgnang	274	11%	*246*	*48%*
	Phakeo	449	7%	*444*	*38%*
	Senphone	143	21%	*129*	*66%*
Thongmixay	Dane	140	21%	*128*	*70%*
	May	287	10%	*138*	*66%*
	Namon	82	37%	*67*	*97%*

* Note: A subdivision of Paktom village (Paktom neua) was surveyed in 2005, explaining the difference in population with 2014

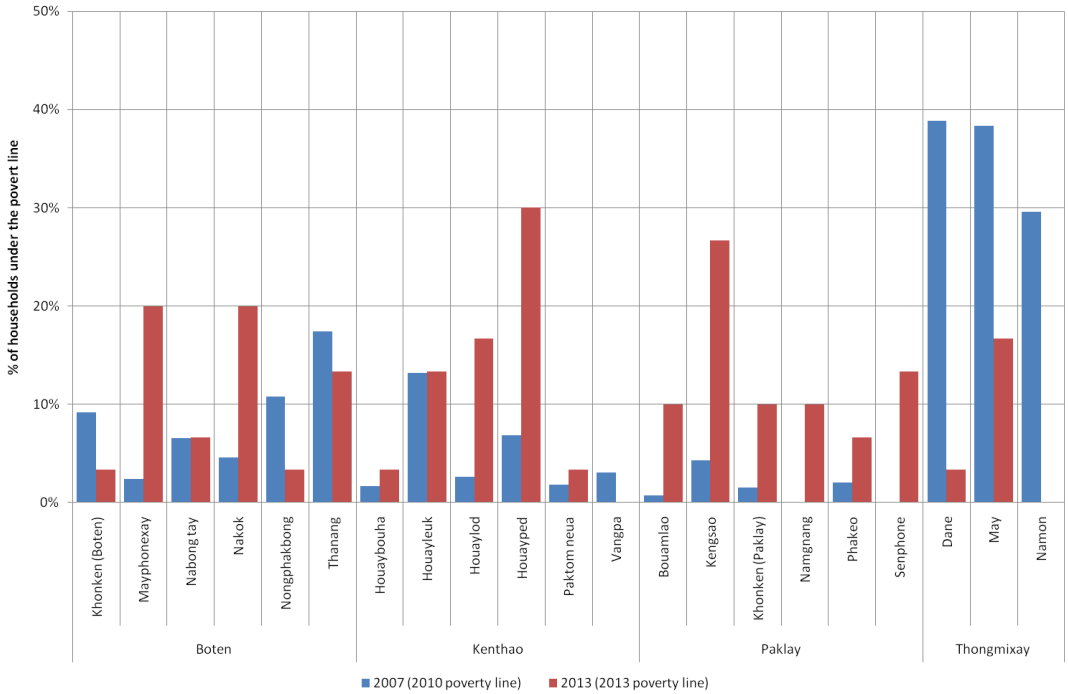
The following sections look at the main livelihood, land use and agricultural changes observed in the target villages when compared to the situation in 2005 and 2008 and reflect on the key potential drivers for these changes. The historical dissemination and current status of CA-based cropping systems is then analyzed and discussed. Finally, the report discusses some of the lessons that can be learned from this experience of CA research and extension in southern Sayaboury Province and concludes on related prospects for the EFICAS (CA-NUDP) project in Laos.

3. Trajectories of livelihood and land use change in the target villages

3.1. Poverty

Building on the national poverty line – set for rural areas at 180,000 LAK (in 2010) and 253,000 LAK (in 2013) per person and per month – to estimate poverty headcounts for 2007 and 2013, a very significant decrease of poverty can be observed in the villages of Thongmixay district. In average for the 3 villages of Thongmixay, the proportion of poor has decreased from 36% to less than 7%. In contrast, several villages of Boten (Mayphonexay and Nakok), Kenthao (Houaylod and Houayped) and Paklay (Bouamlao, Kengsao, Khonken, Namgnang and Senphone) display alarming increases in poverty headcount. In Houayped and Kengsao for instance, poverty has increased at an annual rate of 4% over the past 6 years, leading to proportions of 25-30% of poor households in 2013. Looking at the same estimates since 2004, the overall trend for the abovementioned villages of Boten, Kenthao and Paklay district seems to be one of a rapid reduction of poverty during the 2004-2007 period followed by a gradual increase until 2013 (Appendix 1, Table 11).

Figure 2. Evolution of poverty in the study villages (2007-2013)



3.2. Incomes and sources

The significant variations in average household incomes that could be observed between study villages in 2007 have generally been maintained in 2013 (Table 2). In 2013, annual incomes among the households surveyed ranged from a minimum of 85,000 THB in Houayleuk (Kenthao) to a maximum of 222,000 THB Khonken (Boten), yet with more comparable values when averaged at the district level – i.e. from 127,000 THB in Thongmixay to 129,000 THB in Kenthao, 159,000 THB in Boten and 162,000 THB in Paklay. Most notably, between 2007 and 2013, the villagers of Thongmixay district appear to have rapidly caught up with the income levels observed in other districts, explaining the significant poverty reduction highlighted above. The 3 study villages of Thongmixay have seen their average household incomes increasing at rates of more than 20% per year over the past 6 years. In contrast, most villages where the poverty headcount has recently increased seem to be characterized by relatively limited increases in household incomes over the years and, for some of these (Houaylod, Houayped, Paktom and Senphone), even slight decreases after 2007.

Looking at the distribution of the incomes within the communities surveyed, it appears that the differentiation process observed by Slaats and Lestrelin (2009) has continued after 2008. In the four districts, inter-household differences in annual incomes have grown rather significantly since 2004, gradually in Boten district, with a particular emphasis between 2004 and 2007 in Kenthao and Paklay and more recently in Thongmixay. This economic differentiation process appears also to be more marked in the case of households with important revenues (Appendix 1, Figure 21, Figure 22, Figure 23 and Figure 24).

Thongmixay district stands out when looking at the evolution of the incomes disaggregated by sources (Figure 3, Figure 4, Figure 5 and Figure 6). In average for the study villages of Thongmixay district, agricultural incomes have increased at an impressive rate of 70% over the past 6 years (making agriculture surpass off/non-farm work as primary income source), while it stagnated or even slightly decreased in other districts. In all four target districts, incomes from off-farm/non-farm activities, including seasonal migration to Thailand, have also increased quite significantly in recent years – making up for most of the 2007-2013 increase in household incomes in Boten, Kenthao and Paklay and surpassing agriculture as primary income source in most villages of Boten district. Finally, in all target districts, livestock farming, cattle and buffalo especially, appears more as a complementary or capitalization activity contributing to 10-15% of the annual incomes in average.

Table 2. Average household incomes (THB per household per year, 2004-2013)

	2004	2007	2013
Boten District	34 203	86 204	158 751
Khonken (Boten)	22 100	80 540	222 210
Mayphonexay	35 174	98 221	109 279
Nabong tay	23 518	72 513	203 040
Nakok	49 293	103 987	149 987
Nongphakbong	36 920	78 007	139 122
Thanang	27 100	68 773	128 867
Kenthao District	41 784	115 895	129 441
Houaybouha	44 011	134 894	216 022
Houayleuk	49 926	78 982	85 683
Houaylod	28 605	118 824	110 118
Houayped	23 877	95 270	92 424
Paktom neua	71 982	177 794	115 066
Vangpa	34 471	111 268	157 332
Paklay District	70 576	139 468	161 802
Bouamlao	74 236	135 512	150 033
Kengsao	76 776	121 499	199 707
Khonken (Paklay)	68 139	135 593	146 023
Namgnang	56 625	152 099	168 183
Phakeo	63 571	125 174	151 400
Senphone	96 711	175 908	155 467
Thongmixay District	20 721	41 407	127 152
Dane	22 271	34 750	129 257
May	16 660	44 487	101 503
Namon	23 386	46 762	150 695
Average 4 districts	47 969	109 194	146 734

Figure 3. Average household incomes and sources in Boten district (THB per year, 2004-2013)[1]

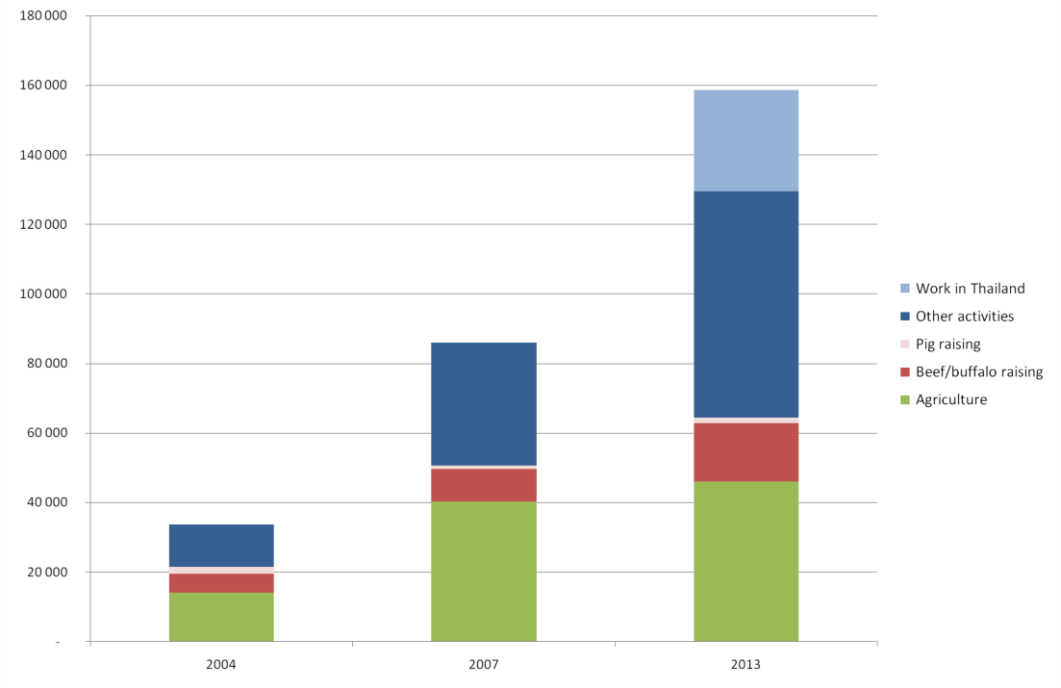
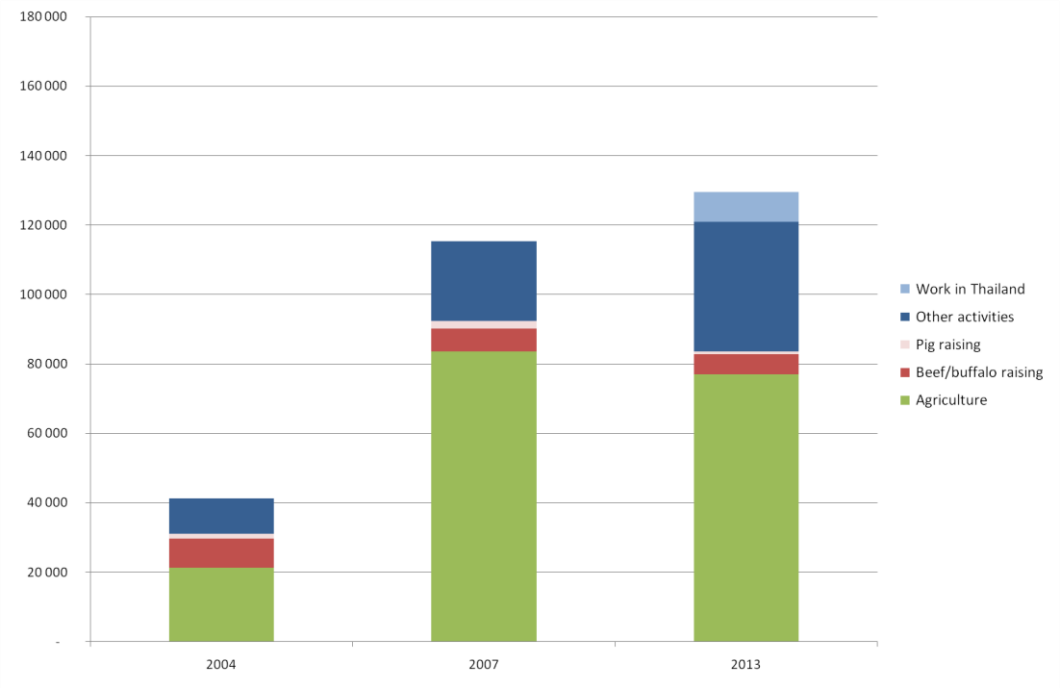


Figure 4. Average household incomes and sources in Kenthao district (THB per year, 2004-2013)[1]



[1] "Work in Thailand" was added as a distinct category in the latest questionnaire survey (2013 data); it was previously included in "Other activities".

Figure 5. Average household incomes and sources in Paklay district (THB per year, 2004-2013)[1]

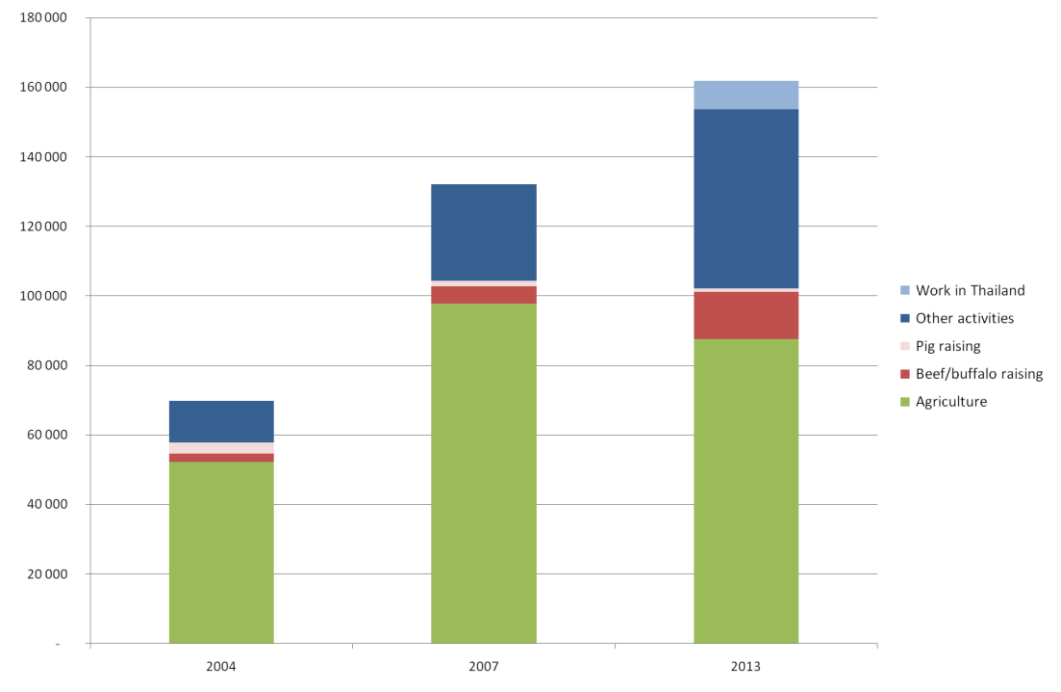
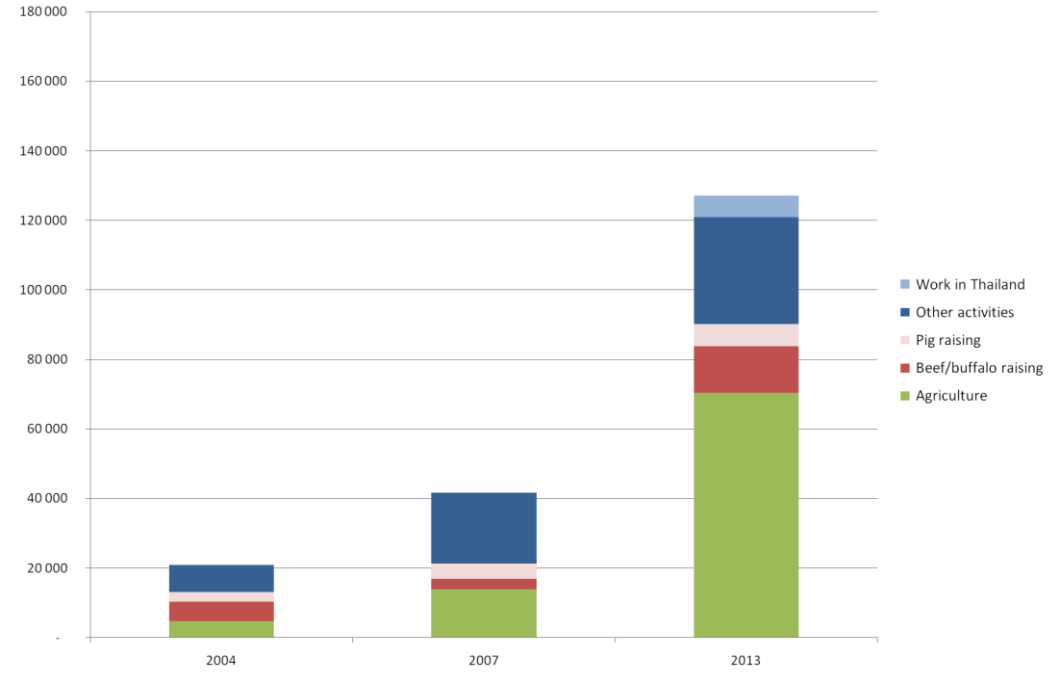


Figure 6. Average household incomes and sources in Thongmixay district (THB per year, 2004-2013)[1]



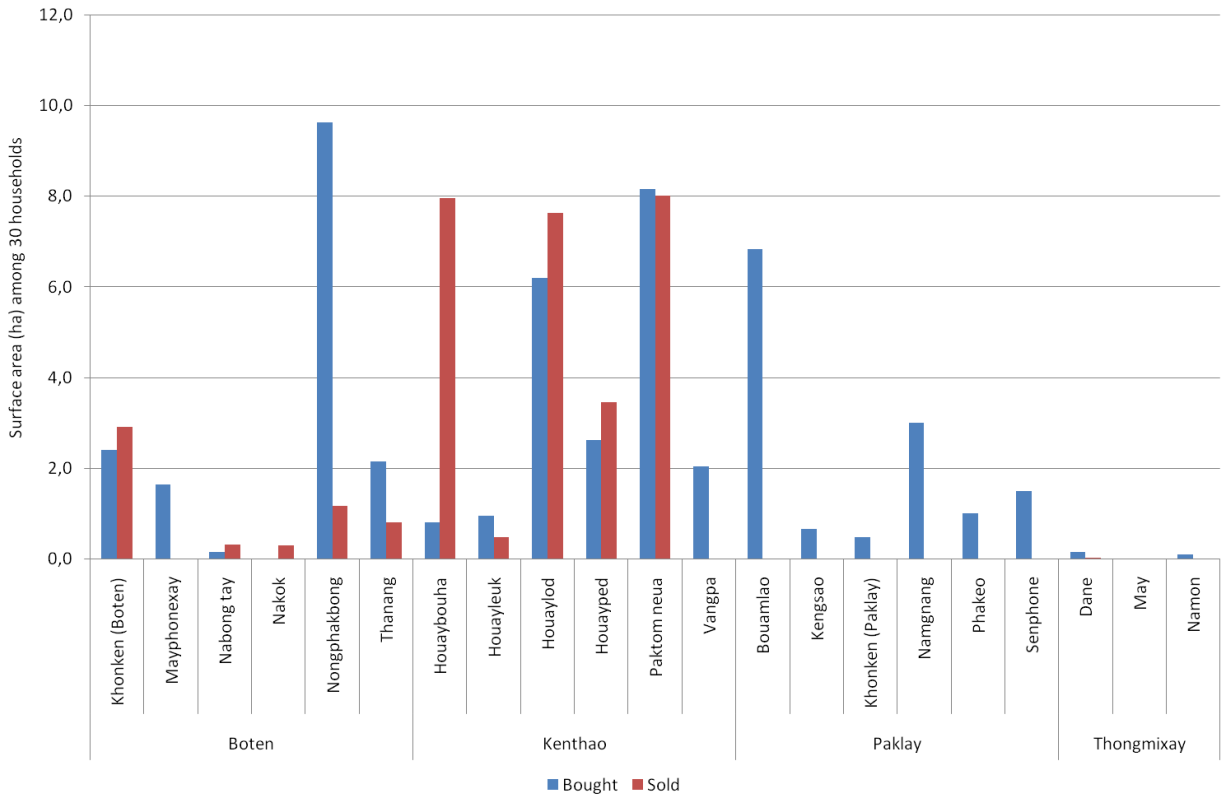
3.3. Land transactions

Looking at the dynamics of land sale and investment over the past five years, there appears to be significant variations from one village to another (Table 3 and Figure 7). At the district level, the balance is positive in Paklay district with only land investments and no sales recorded among the household samples of the six target villages. Although there can be no certainty (given that our samples may not allow capturing the full extent of land transactions within villages), this trend may suggest that new land has been made available for investment during the past five years. The balance is also positive in Boten with particularly significant land investments in Nongphakbong village – again suggesting that new land might have been made available for agricultural expansion. Villages in Kenthao district display similar dynamics of land transaction but, overall, a negative balance especially with important land sales in the villages of Houaybouha, Houaylod and Paktom, both in terms of households involved and average surface areas sold. In line with the abovementioned decrease in agricultural incomes, this may indicate a slight disengagement from agriculture from the part of some villagers (although no statistical correlations can be observed between land sales and income sources – see Table 22). In contrast, very few and only small land investments have been reported in Thongmixay district.

Table 3. Land investment/sale by villagers over the past five years (frequency and average surfaces)

	Land investments (2010-2014)		**Land sales (2010-2014)**	
	% of households	**Average surface (ha)**	**% of households**	**Average surface (ha)**
Boten District	7%	1,33	4%	0,69
Khonken (Boten)	3%	2,40	7%	1,46
Mayphonexay	7%	0,82	0%	
Nabong tay	7%	0,08	3%	0,32
Nakok	0%		3%	0,29
Nongphakbong	13%	2,41	7%	0,58
Thanang	10%	0,72	7%	0,40
Kenthao District	9%	1,22	9%	1,72
Houaybouha	3%	0,80	17%	1,59
Houayleuk	7%	0,48	3%	0,48
Houaylod	10%	2,07	10%	2,54
Houayped	17%	0,53	10%	1,15
Paktom neua	10%	2,72	13%	2,00
Vangpa	10%	0,68	0%	
Paklay District	6%	1,35	0%	
Bouamlao	13%	1,71	0%	
Kengsao	7%	0,33	0%	
Khonken (Paklay)	3%	0,48	0%	
Namgnang	3%	3,00	0%	
Phakeo	3%	1,00	0%	
Senphone	3%	1,50	0%	
Thongmixay District	2%	0,13	1%	0,02
Dane	3%	0,16	3%	0,02
May	0%		0%	
Namon	3%	0,10	0%	
Total 4 districts	10%	1,24	6%	1,50

Figure 7. Land transactions concluded by interviewed villagers over the past five years (hectares sold/bought, 2010-2014)



3.4. Paddy rice and self-sufficiency

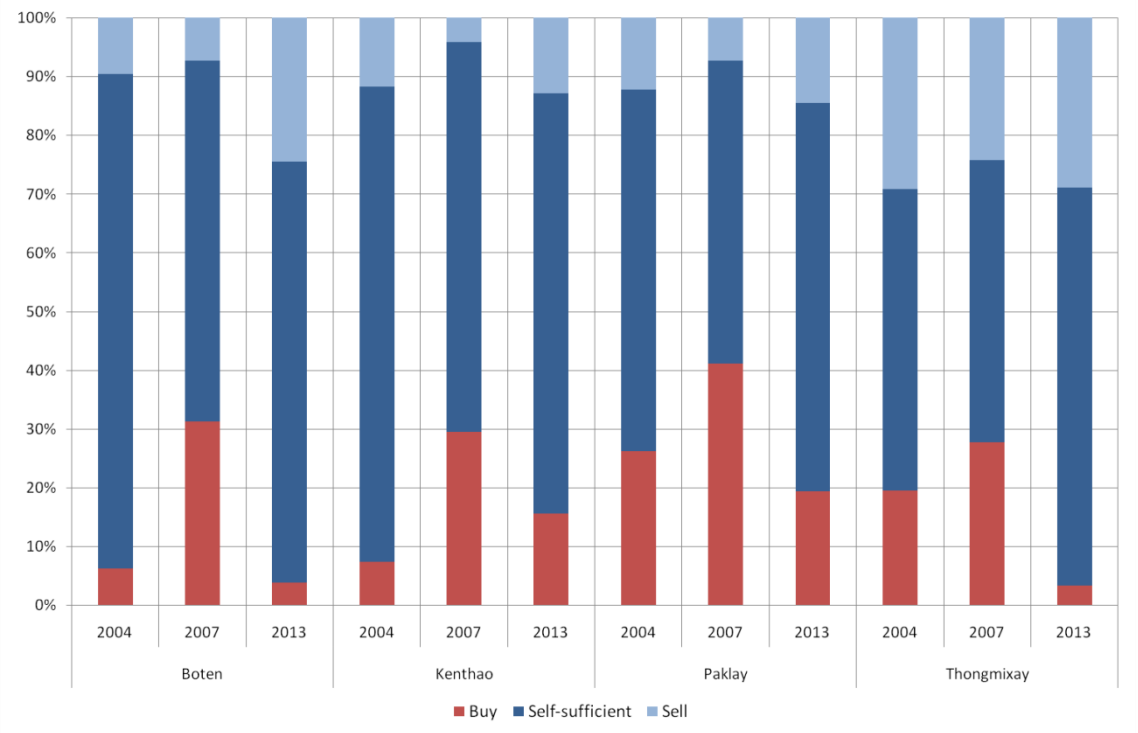
Households' access to paddy land has generally remained similar to what it was in 2008 (Table 4 and Appendix 1, Table 12), at the exception of most study villages in Kenthao district where it has increased quite significantly over the past six years. In addition, the average paddy land cultivated per household appears to have gradually increased in Boten, Kenthao and Paklay districts (Table 4 and Appendix 1, Table 13). In Boten district, the recorded increase between the 2005, 2008 and 2014 samples is statistically significant (Kruskal-Wallis test at the 0.05 level), suggesting continued investments from local populations into paddy land development. Surprisingly, the surfaces of paddy land cultivated appear to have slightly decreased in Thongmixay, a trend that is also statistically significant and which may result from a minor displacement of farm labour from paddy cultivation towards upland cash crops like Job's Tears (see below).

Table 4. Access to paddy land (percent of households and average surface per household, 2005-2014)

	2005		**2008**		**2014**	
	Households (%)	*Avg surface (ha)*	*Households (%)*	*Avg surface (ha)*	*Households (%)*	*Avg surface (ha)*
Boten	90%	0,71	88%	0,74	89%	0,85
Kenthao	71%	0,53	74%	0,51	82%	0,56
Paklay	70%	0,58	73%	0,58	74%	0,61
Thongmixay	90%	0,77	88%	0,73	90%	0,65

Despite this small areal decrease and similar to all other target districts, the level rice self-sufficiency of Thongmixay villagers has significantly increased over the past six years (Figure 8). This general trend follows an initial period of decreasing self-sufficiency during the 2004-2007 period and may reflect different factors – e.g. increase in agricultural productivity with better access to inputs or improved varieties and techniques, reinvestment of labour in staple crops like paddy rice after the maize boom of the 2000s, inter-annual climatic variations, etc.

Figure 8. Rice self-sufficiency (percent of households, 2004-2013)



3.5. Upland crops

Significant trends of crop diversification (i.e. increase in the mean number of upland crops cultivated per household annually) can be observed in the uplands of Boten, Kenthao and Paklay districts, while a trend of specialization into Job's Tears production is observed in Thongmixay (Table 5). As illustrated in Figure 10, Figure 11, Figure 12 and Figure 13, the diversification process goes along with a significant decrease in maize production area in Boten and Kenthao districts, while crop diversification is implemented additionally to maize cultivation in Paklay district (no change in maize production area). Cassava, peanut, sesame and pasture constitute the main land uses involved in the diversification process. Although their extent remain fairly marginal compared to annual crops, perennial tree crops – especially teak and rubber – have also recently expanded in villages of Boten, Kenthao and Paklay districts.

As illustrated by Figure 9, over the past ten years, upland agriculture has expanded very significantly in most target villages. In villages like Vangpa (Kenthao) and Namgnang (Paklay) for instance, agricultural expansion has translated in more than 80 additional hectares being developed every year since 2005. Similarly, in nine years, villages like May and Namon (Thongmixay) have seen their upland cultivated areas increasing by a factor of five. Looking at the most recent years however, different trends can be observed. Overall, the mean cultivated area per household has increased quite sharply since 2008 in Paklay and Thongmixay districts, suggesting that new land has been made available and/or developed for upland cultivation (see the above land investment trend in Paklay). In contrast, the mean cultivated area is decreasing slightly in several villages of Boten district and more significantly throughout Kenthao district which, in the light of the abovementioned shift to off/non-farm activities, may indicate a de-agrarianization trend (possibly linked to land degradation, decreased land productivity, increased labour costs and/or decreased labour availability). Building village-level estimates from data collected among our 30 household samples, it appears that upland crops covered over 15 500 ha in the 21 study villages in 2014; around 1 850 ha, including 830 ha of maize, in villages of Boten district, around 6 000 ha, including 4 620 ha of maize, in Kenthao, around 6 670 ha, including 5 290 ha of maize, in Paklay, and around 1 000 ha, including 875 ha of Job's Tears, in Thongmixay (Appendix 1, Table 14, Table 15, Table 16 and Table 17).

Table 5. Agricultural diversification (average number of upland crops per household, 2003-2014)

	2003	2008	2014
Boten District	2,2	2,3	2,6
Khonken (Boten)	1,3	1,9	1,7
Mayphonexay	2,9	1,8	3,0
Nabong tay	1,5	2,2	1,5
Nakok	1,4	1,2	1,4
Nongphakbong	2,5	3,6	4,0
Thanang	2,4	3,0	3,6
Kenthao District	2,0	1,9	2,2
Houaybouha	2,3	2,2	2,3
Houayleuk	1,7	2,1	2,1
Houaylod	1,6	1,4	2,4
Houayped	1,8	1,3	1,7
Paktom neua	2,5	1,9	2,9
Vangpa	2,0	2,4	1,9
Paklay District	1,4	1,2	2,3
Bouamlao	1,5	1,2	2,3
Kengsao	1,6	1,0	1,7
Khonken (Paklay)	1,5	1,2	2,7
Namgnang	1,3	1,1	2,5
Phakeo	1,5	1,3	2,3
Senphone	1,3	1,0	2,4
Thongmixay District	1,6	1,5	1,4
Dane	1,7	1,5	1,3
May	1,3	1,4	1,1
Namon	1,7	1,8	1,7
Average 4 districts	1,8	1,7	2,2

Figure 9. Agricultural expansion in the uplands (hectares and increase rates, 2005-2014)[2]

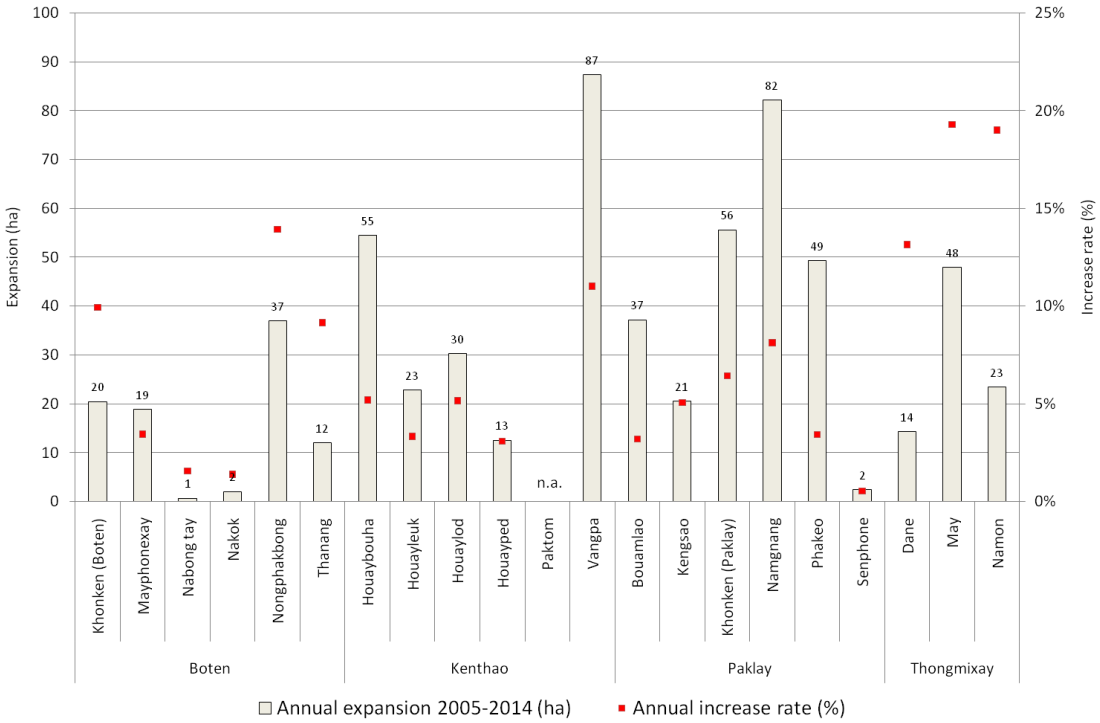
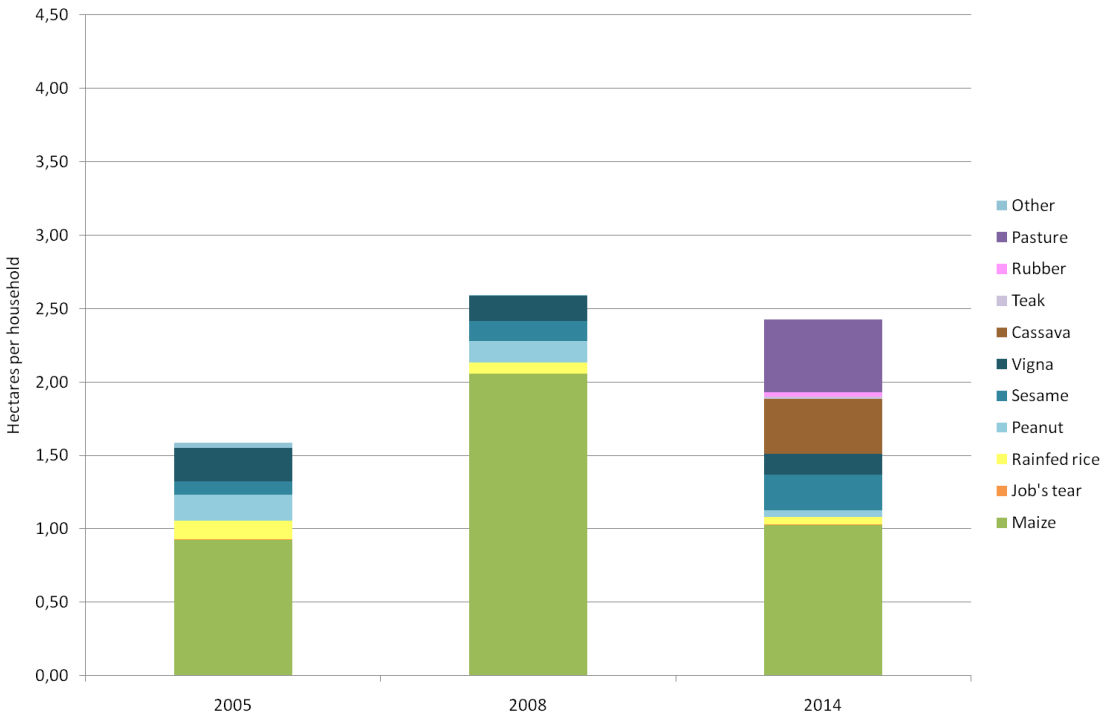


Figure 10. Average surface areas of upland crops in Boten district (hectares per household, 2005-2014)



[2] Village level estimates are calculated using the values reported by the household samples proportioned to the actual population of the villages in 2005 and 2014

Figure 11. Average surface areas of upland crops in Kenthao district (hectares per household, 2005-2014)

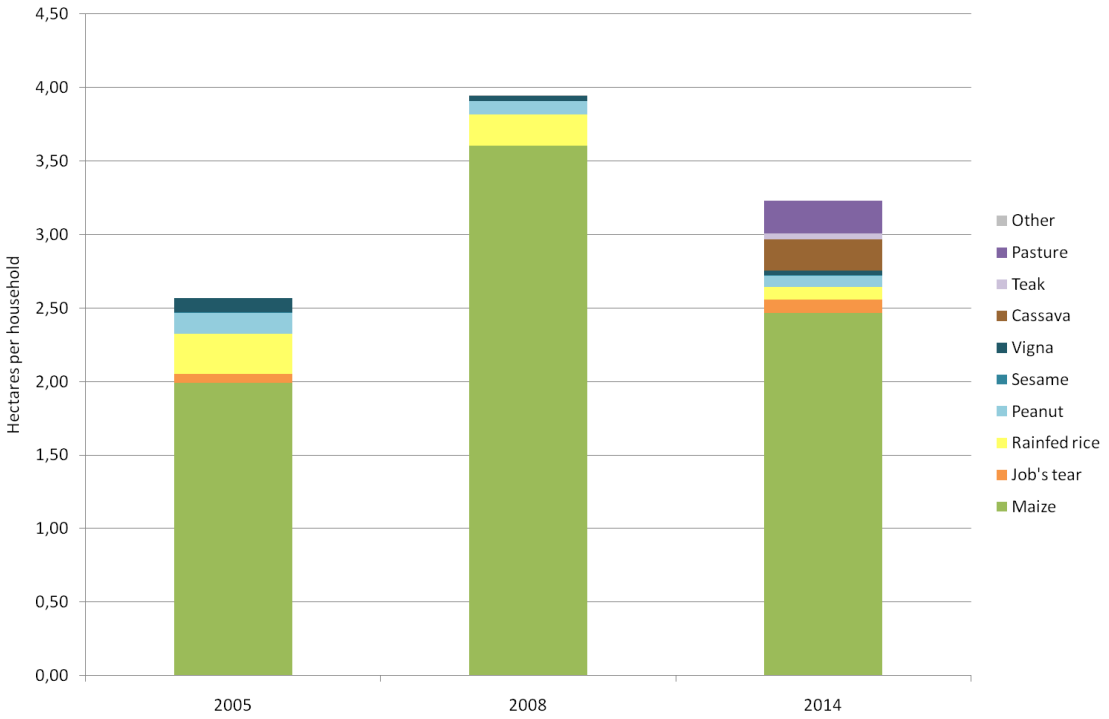


Figure 12. Average surface areas of upland crops in Paklay district (hectares per household, 2005-2014)

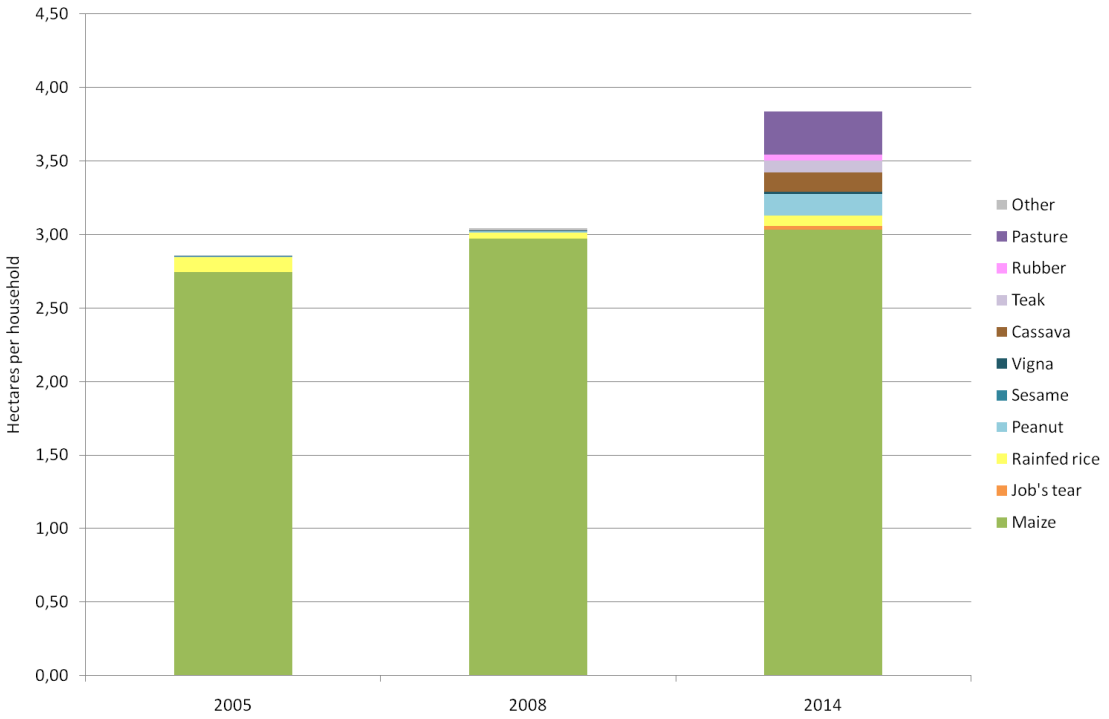
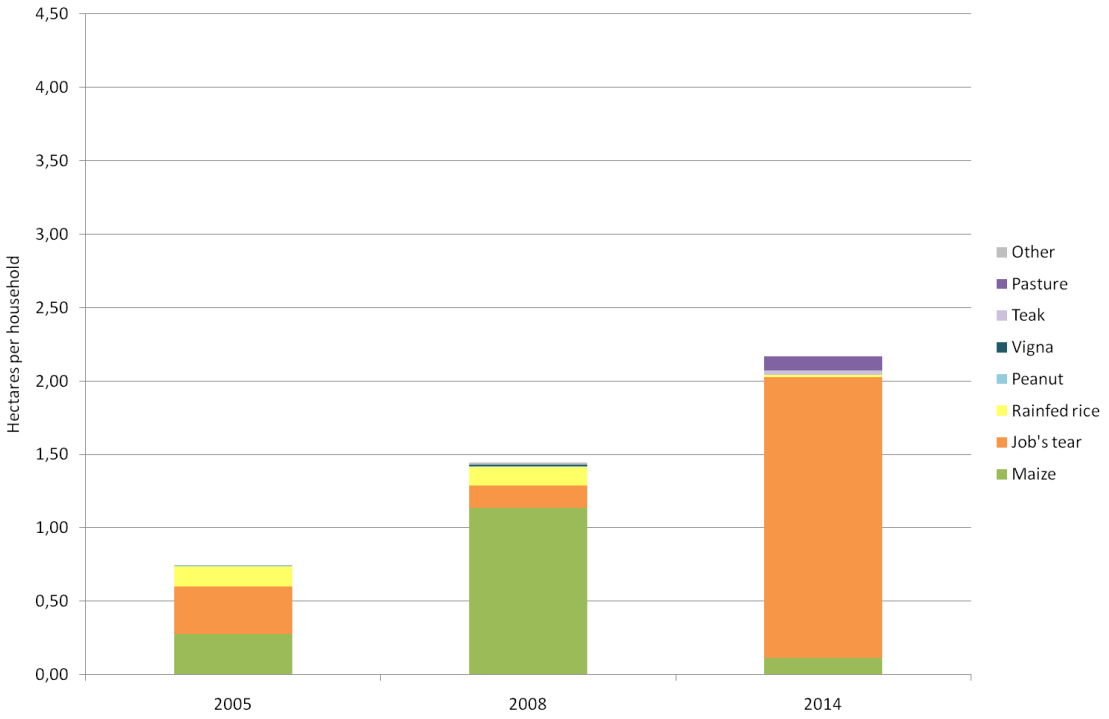


Figure 13. Average surface areas of upland crops in Thongmixay district (hectares per household, 2005-2014)



3.6. Herbicides

After a rapid expansion during the 2000s, herbicide use appears to have decreased over the past six years. This is especially true in Paklay district where a 10-point decrease in the percentage of households applying herbicides on their land can actually be observed (Table 6). A comparison (Mann-Whitney test at the 0.05 level) of the 2008 and 2014 samples for all 21 study villages confirms the statistical significance of this trend which may be related to the abovementioned shift towards off-farm/non-farm activities. Indeed, at the household level, a negative correlation can be observed between herbicide use and off/non-farm income generation (Appendix 1, Table 22).

Table 6. Herbicide use (% of households, 2005-2014)

	2005	**2008**	**2104**
Boten	20%	62%	56%
Kenthao	23%	82%	77%
Paklay	70%	94%	84%
Thongmixay	0%	67%	66%
Total	**37%**	**80%**	**71%**

Service provision activities for herbicide application have not developed at a broader scale than in 2008 (Appendix 1, Table 18), although they could have contributed to better control of pesticide utilization and reduced health risks for farmers. Quite the contrary, the increased health hazard linked to the rapid spread of motorpumps and anticipated in earlier reports (Saioudom 2008; Slaats and Lestrelin 2009) has become a reality with an overwhelming majority of households of the four target districts using motorpumps for applying herbicide on their land (Table 7). Turning to the types of herbicide used (Appendix 1, Table 19), it appears that Glyphosate is now primarily used in both conventional and conservation agriculture systems and that Gramoxone is still commonly applied to remove creeping Graminae and Dicotyledonae germs after sowing. In contrast, the popularity of Atrazine – a controversial molecule widely used in the USA but banned in the EU since 2004 – has decreased after 2008.

Table 7. Herbicide application techniques (% of households, 2005-2014)

		2005	2008	2014
Boten	Sprayer	100%	80%	0%
	Motopump	0%	20%	100%
Kenthao	Sprayer	81%	79%	1%
	Motopump	19%	13%	99%
Paklay	Sprayer	88%	67%	0%
	Motopump	12%	33%	100%
Thongmixay	Sprayer	0%	97%	5%
	Motopump	0%	3%	95%

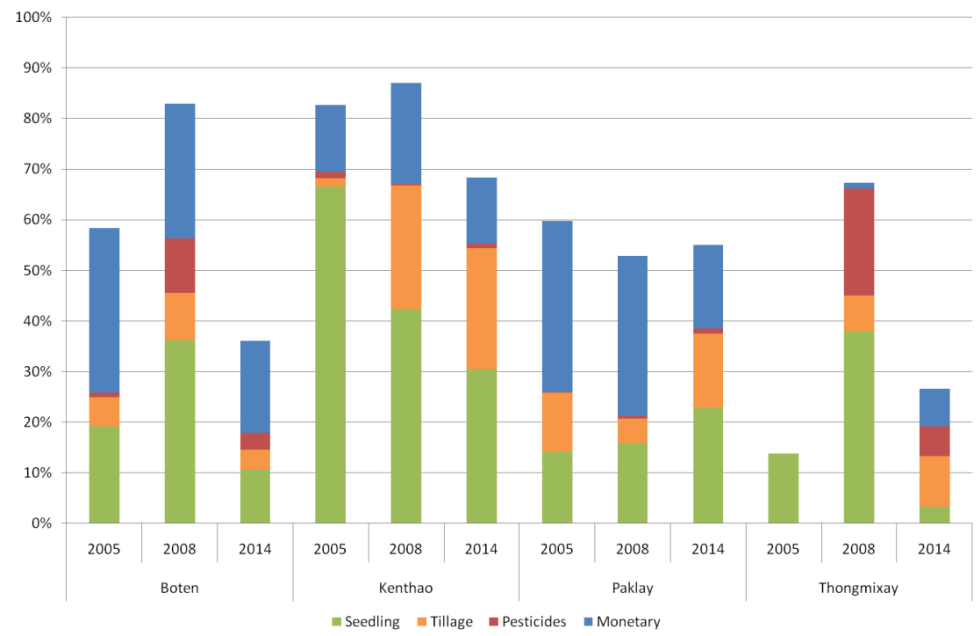
3.7. Access to credit

While more than 70% of the households in the four target districts were engaged in some form of credit in 2008, this proportion has considerably decreased in recent years in Boten, Kenthao and Thongmixay districts (Table 8). The main purposes of credit have not changed in Boten and Kenthao – i.e. cash provision and purchase of seeds in the former, purchase of seeds and tillage services in the latter (Figure 14). In Thongmixay however, the sharp decrease in household recourse to credit appears largely the result of villagers not relying anymore upon credit for purchasing seeds, which in turn is probably linked to the abovementioned Job's Tears 'boom' (i.e. unlike maize cultivation which involves purchase of hybrid seeds, Job's Tears is replanted with harvested seeds).

Table 8. Access to credit (% of households, 2005-2014)

	2005	2008	2104
Boten	58%	83%	36%
Kenthao	83%	87%	68%
Paklay	60%	53%	55%
Thongmixay	14%	67%	27%
Total	**62%**	**72%**	**49%**

Figure 14. Main credit purpose (% of households and relative frequency of purposes, 2005-2014)



3.8. Livestock raising

Cattle and buffalo raising is widely practiced in the study area (Table 9), with a general trend of increase of the average farm size (Figure 15). This increase definitely plays a part in the diversification process discussed in Section 3.5 and can be associated with the significant expansion of pastureland observed in the upland areas of Boten, Kenthao and Paklay districts. At the same time however, a significant decrease in the proportion of villagers engaged in cattle/buffalo raising can be observed in five out of the six study villages of Kenthao district. Although information provided by the questionnaire survey is not sufficient to test the hypothesis, according to key informant interviews conducted in the area, this decrease may actually reflect a broader change in the production system with cattle being increasingly raised by traders (or other non-local investors) on large plots of land bought to villagers who, in turn, are gradually shifting to off/non-farm activities. In contrast, while it had strongly decreased during the 2005-2008 period, the involvement of villagers in pig raising has remained relatively steady after 2008 (Table 10).

Table 9. Villagers engaged in cattle/buffalo raising (% of households, 2005-2014)

	2005	**2008**	**2104**
Boten	72%	59%	59%
Kenthao	69%	50%	30%
Paklay	43%	45%	47%
Thongmixay	56%	62%	62%
Total	**59%**	**52%**	**48%**

Figure 15. Evolution of cattle/buffalo farm sizes (% of farmers, 2005-2014)

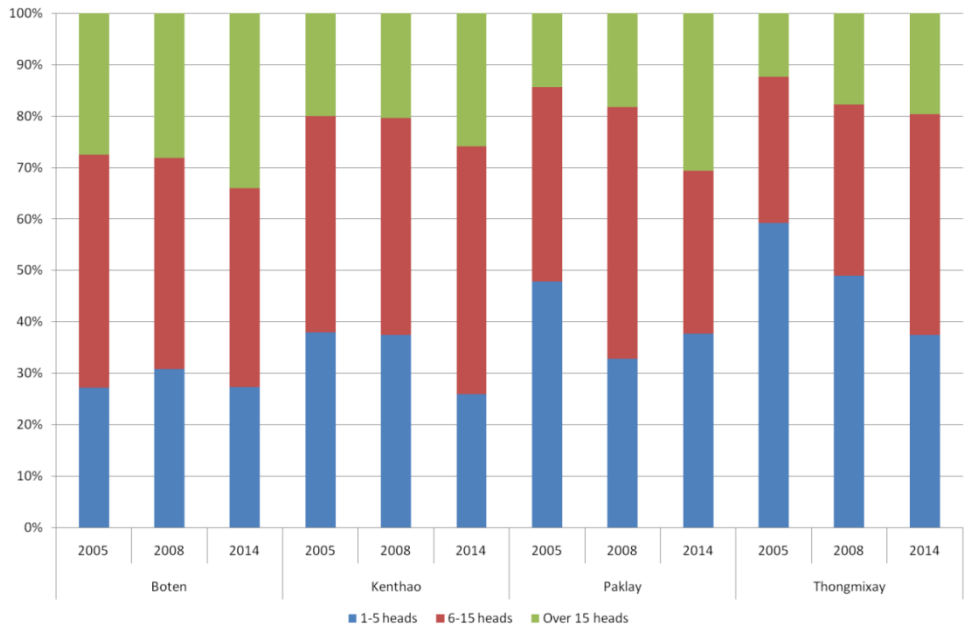


Table 10. Villagers engaged in pig raising (% of households, 2005-2014)

	2005	**2008**	**2104**
Boten	61%	27%	39%
Kenthao	42%	25%	20%
Paklay	63%	39%	34%
Thongmixay	94%	63%	67%
Total	**59%**	**34%**	**36%**

Box 1. Main hypotheses on driving forces and causality linkages for observed livelihood and land use changes

1. The Job's Tears boom in Thongmixay is likely to have played a major role in increasing household incomes and driving significant poverty reduction after 2008

2. Maize-based cropping systems appear to have reached their limits in Boten and Kenthao districts as reflected in decreasing surface areas, agricultural diversification and a shift to off/non-farm activities (including seasonal work in Thailand). Various farm-level drivers (possibly combined) could explain this trend: land degradation, increased labour costs, decreased labour availability, etc. Market price variations (see Appendix 1, Figure 25) and recurrent issues linked to maize sale (e.g. repeated bans on maize exportation imposed by the Thai government, delayed payment by traders) have probably also fostered economic diversification

3. The trend of diversification observed in Paklay would be more related to emerging market opportunities (cassava factory established in the district, new border checkpoint with Uttaradit Province and better marketing channels for peanut, sesame, etc.)

4. While agricultural expansion in Thongmixay district is likely to have occurred 'spontaneously' on uncultivated or fallow land, in Paklay and some villages of Boten (e.g. Nongphakbong), new land may have been made available by the district authorities for agricultural expansion

5. Villagers of Boten district have made continued investments into paddy land development, whereas in Thongmixay, decreased surfaces of paddy land per household might reflect a minor displacement of farm labour from paddy cultivation towards upland cash crops like Job's Tear

6. Greater rice self-sufficiency could have been driven by an increase in agricultural productivity (better access to inputs, improved varieties and techniques...) and a reinvestment of labour in staple crops like paddy rice after the maize boom of the 2000s

7. A significant decrease in herbicide use by households can be observed throughout the study area, a trend that appears correlated to the broader shift towards off/non-farm activities

8. Significant decrease in the proportion of Kenthao villagers engaged in cattle/buffalo raising may reflect a broader change in the production system, with cattle being increasingly raised by traders (or other non-local investors) on land bought to villagers who are gradually shifting to off/non-farm activities

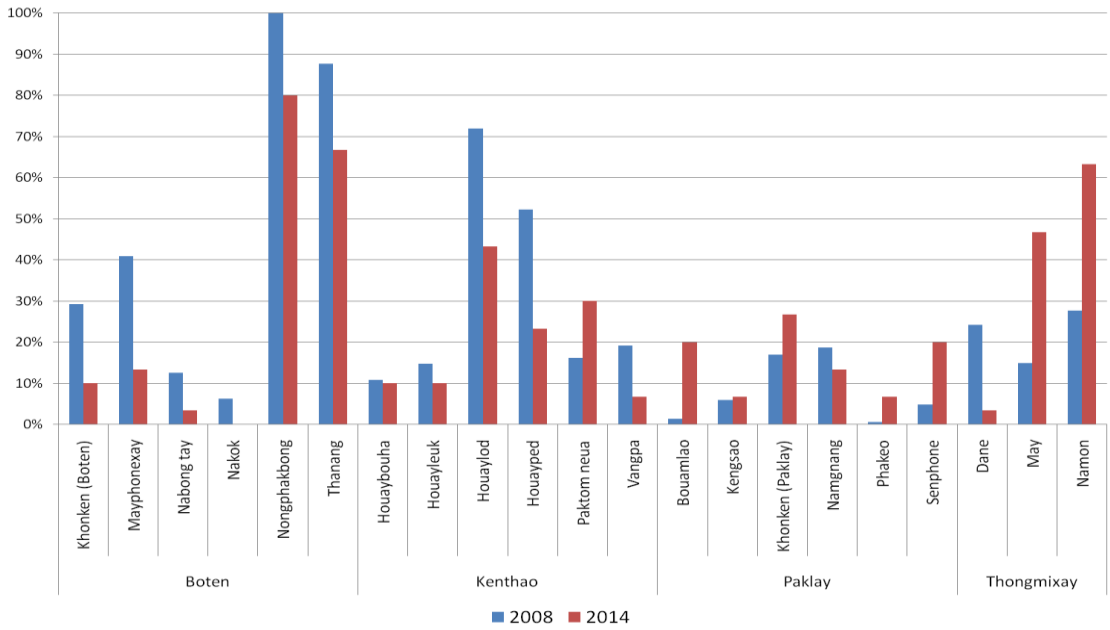
9. Put together, income diversification, the importance of seasonal work in Thailand, land sales and growing investments by non-local actors in cattle/buffalo raising may, in some villages of Kenthao district especially, reflect a broader 'proletarianization' process. As a result of adverse market conditions and/or land degradation, local farmers could be pushed to abandon agriculture and become wage labour for the Thai agricultural and manufacturing industry

4. Status of CA in the target villages

4.1. Trends in adoption and spatial extent

Different trends in the use of DMC techniques can be observed over the past six years (2008-2014) at the district and village levels. In Boten and Kenthao districts, the number of DMC practitioners has decreased as compared to 2008 (Figure 16). In average, the proportion of farmers applying DMC techniques has decreased from 46% to 30% in Boten and from 31% to 21% in Kenthao since 2008. In some villages, this proportion has become equal or close to 0% (e.g. Nabongtay and Nakok) while, in other villages, CA techniques remain very popular (e.g. Nongphakbong and Thanang). In contrast, the average number of DMC practitioners has doubled in the two other target districts, reaching 16% of farmers in Paklay and 38% in Thongmixay. Again, some differentiation can be also observed at the village level, with decreases in the number of practitioners in Namgnang (Paklay) and Dane (Thongmixay) and increases in all the other study villages.

Figure 16. Use of CA techniques (percent of households, 2008-2014)



Similar adoption levels and dynamics can be observed when looking at the extent of the different land preparation techniques (tillage, DMC and slash-and-burn). Compared to the situation in 2008, there is now less land cultivated using DMC techniques in Boten and Kenthao districts (Figure 17 and Figure 18). This contraction of DMC's spatial extent goes along with a relative increase in tillage practices that could be related to a reduction of the maize production area (see above, Figure 10 and Figure 11) and its partial replacement by cassava production, which requires tillage for planting and harvesting, and pasture, often established through tillage and planting of forage on fallow land (Appendix 1, Table 23). Yet, in villages like Nongphakbong and Thanang (Boten) where DMC constituted the primary land preparation technique in 2008, the surface areas concerned still remain quite significant.[3] Slight areal increases in land prepared with DMC techniques can also be observed in villages like Houaybouha, Houayleuk and Paktom in Kenthao district, which might reflect the efforts of the CADF Secretariat towards structuring and training of farmer group.

In Paklay district, the relative extent of land cultivated with DMC techniques has increased but remains clearly below 10% of the total upland area cultivated in all study villages (Figure 19). Thongmixay district displays a more heterogeneous situation as the extent of DMC has decreased in Dane but strongly increased in May and Namon. In the latter villages, DMC techniques appear to have spread spontaneously and are currently applied

[3] According to the head of DAFO in Boten district, DMC maize monocropping with hand-job seeders remains a very efficient and popular cropping system for the cultivation of remote upland areas.

on more than 50% of the cultivated upland area (Figure 20). This dynamics could have been favoured by (i) the recent boom in Job's Tear cultivation (high residue production, hence high potential for residue retention under such crop) and (ii), as reported during key informant interviews in the district, continued commitment from local DAFO staffs and district authorities to raise farmers' awareness and promote DMC techniques.

Remarkably, a relative expansion of slash-and-burn practices can also be observed in some villages of Boten (Khonken, Nakok and Nabongtay) and Paklay (Kengsao and Phakeo) which seems to be related to the development of teak plantations and pasture commonly established through slash-and-burn (Appendix 1, Table 23) and, perhaps to some extent, the willingness of farmers to limit their production costs (notably related to tillage) for other upland crops. Overall, deriving village-level estimates from data collected among our 30 household samples suggests that some 1440 ha were cultivated using DMC techniques in the 21 study villages in 2014; 225 ha in Boten district, 575 ha in Kenthao, 235 ha in Paklay and 405 ha in Thongmixay (Appendix 1, Table 24, Table 25, Table 26 and Table 27).

Figure 17. Relative extent of the different land preparation techniques in Boten district (% of cultivated land, 2008-2014)

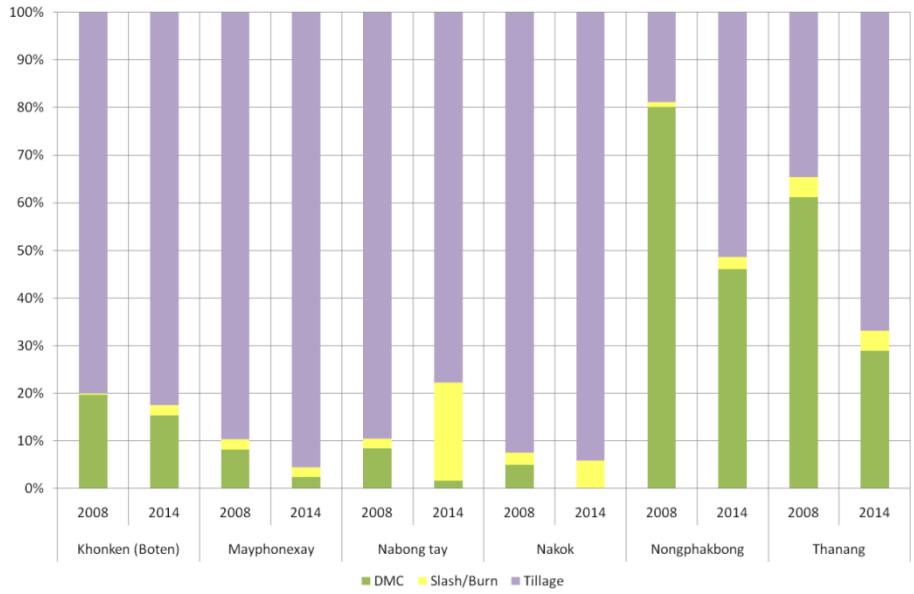


Figure 18. Relative extent of the different land preparation techniques in Kenthao district (% of cultivated land, 2008-2014)

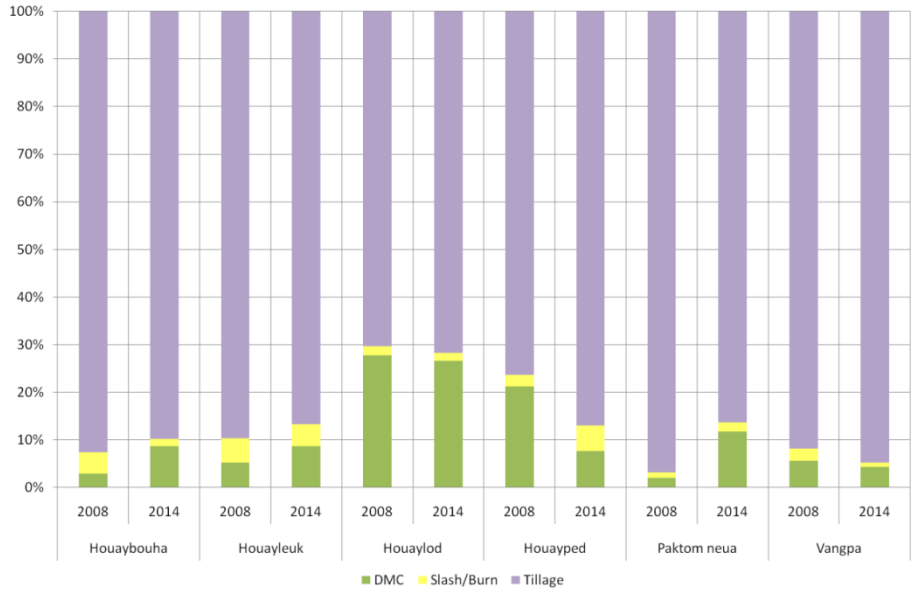


Figure 19. Relative extent of the different land preparation techniques in Paklay district (% of cultivated land, 2008-2014)

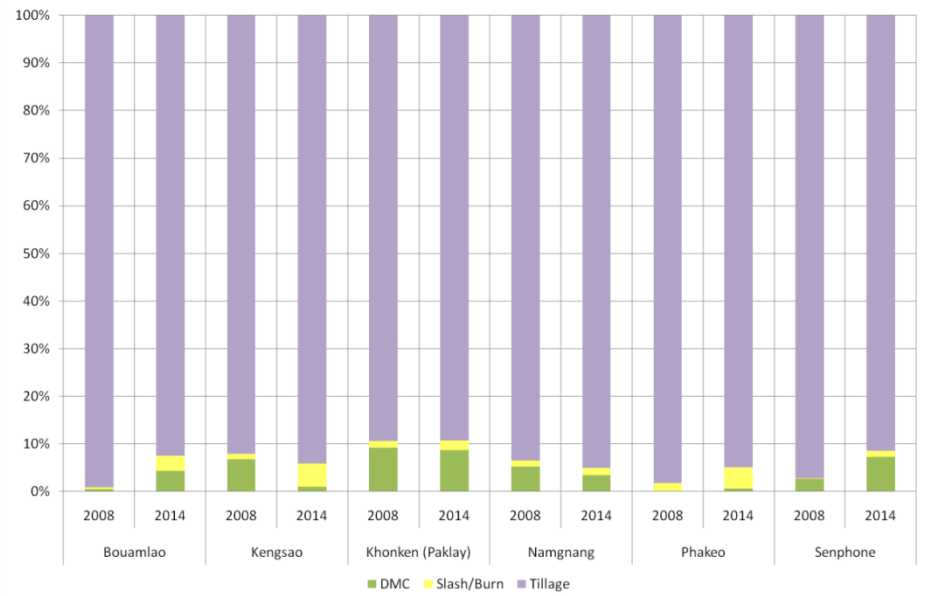
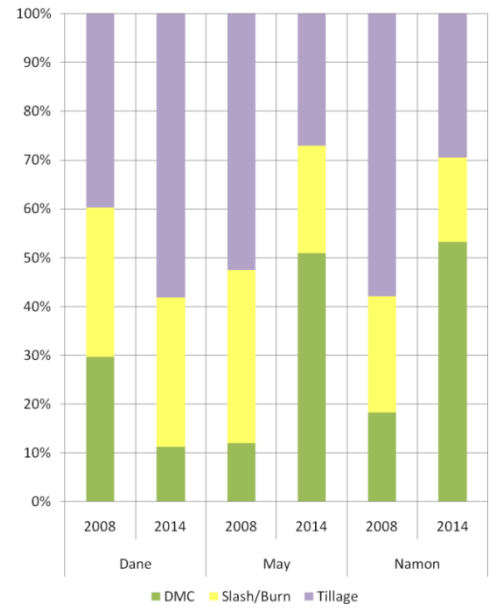


Figure 20. Relative extent of the different land preparation techniques in Thongmixay district (% of cultivated land, 2008-2014)



Box 2. Main hypotheses related to the use of CA techniques

1. Driving forces
   1.1. In line with the conclusions of previous studies (Lestrelin et al. 2012), current CA adoption rates observed in erosion prone sandstone-argillite landscapes suggest that land degradation and soil erosion issues would still constitute key factors pushing farmers to use CA techniques. This is notably the case in Nongphakbong and Thanang villages of Boten district where CA practitioners, though in decreasing numbers since 2008, sill represent 65 to 80% of the farmers

   1.2. Despite very limited farm extension activities over the past five years, the persistence of DMC systems in the agricultural landscape of southern Sayaboury Province may also be explained by the economic efficiency of these systems and the willingness of farmers to control/reduce their production costs in a context of increasing labor costs (see Lestrelin et al. 2012). This would notably be a key factor explaining the joint expansion of Job's Tear and DMC systems in Thongmixay district

   1.3. Increases in the spatial extent of DMC in May and Namone villages of Thongmixay district and Houaybouha, Houayleuk and Paktom villages of Kenthao district could be related to continued sensitization and technical support – i.e. continued commitment from DAFO staffs and district authorities in Thongmixay and efforts of the CADF Secretariat for sensitization, structuring of farmer groups and technical training in Kenthao

   1.4. As highlighted in Boten district, DMC systems with hand-job seeders are especially efficient and preferred by farmers for the cultivation of remote upland areas that can hardly be developed through tillage-based systems

2. Hindering forces
   2.1. Crop diversification towards cassava, peanut, and perennial land uses (e.g. pasture, tree crops) favors tillage-based agriculture. Thus, decreasing maize production area and its partial replacement by cassava production and pasture are probably proximate drivers for the reduction of DMC's spatial extent in Boten and Kenthao districts

   2.2. In the absence of dedicated equipment for no-till cultivation (e.g. no cutting disks for use of mechanical seeders on mulch), agricultural expansion processes such as those observed in Paklay are likely to be primarily realized through tillage-based agriculture

4.2. Lessons learned on the opportunities and constraints to CA dissemination

Previous research conducted in Sayaboury Province (e.g. Slaats and Lestrelin 2009; Lestrelin and Castella 2011; Lestrelin et al. 2012) concluded that the dissemination of CA would benefit from better awareness of farmers on issues of land degradation and agricultural productivity, diversified market opportunities and access to agricultural machinery, structuring of specific farmer groups and service provision activities, and more generally, targeted farm extension accounting for local agroecological transition pathways. Thus, in 2008, several villages in Boten and Kenthao districts could be considered as favourable contexts for CA dissemination (e.g. reported land degradation issues, support from local elites, markets for secondary crops, etc.) and displayed very positive dynamics of CA adoption. This was notably the case in Nongphakbong and Thanang in Boten district or Houaylod and Houayped in Kenthao district. But in 2014, six years after the end of the PASS project and associated support to farm extension services, these villages appear to have somewhat deviated from their previous "pathway" and engaged into land-use diversification (with the development of cassava and pasture) and de-agrarianization (with the development of off/non-farm activities and migrant work in Thailand).

As illustrated with Job's Tear in Thongmixay district, diversified market opportunities have certainly played a role in facilitating the adoption of CA-based cropping systems. But in the end, this role has been the same than with maize ten years earlier in other districts, namely providing sufficient incomes for farmers to cover the costs associated with agricultural intensification and mechanisation. Likewise, improved access to markets for 'secondary' crops such as Vigna umbellata in Paklay and Kenthao districts and facilitated access to machinery, especially 2 to 4-lines mechanical seeders, have in effect not translated into the dissemination of more complex and sustainable intercropping and rotation systems. Quite the contrary, it appears that mechanical seeders – which introduction has long been promoted and supported by the PRONAE and PASS projects and the CADF as a way to reduce labour costs in CA and facilitate adoption by farmers – are now commonly used in conventional agriculture. Crop diversification and mechanization can certainly be considered positive trends that contribute to increase labour productivity and the resilience and sustainability of the agricultural industry. However, without specific research-and-development activities, both agronomic (e.g. CA-based cassava cropping systems) and technical (e.g. mechanical seeders adapted to mulch-based systems), the two trends have actually favoured a general decline of CA practices.

Another important missing link appears to be the intervention of the farm extension services, especially in their missions of technical support to farmers and structuring of the production and service provision sectors. As reported by the CADF Secretariat, the slight areal increase in CA observed in Houaybouha (Kenthao district), Bouamlao and Phakeo (Paklay district) in recent years would be linked to the direct intervention of CADF officers for structuring CA production groups and supporting acquisition of mechanical seeders by farmers. In other settings, CA-related activities have been concentrated on the maintenance of a few demonstration sites per district and, at the village level, appear to have virtually stopped in the few years that have followed the end of the PASS project – more or less early depending on support and commitment from district authorities and staff turnover in Agriculture & Forestry Offices.

Designed as a tool to support CA extension and dissemination activities in the entire province, the CADF has not been able to fulfil its role due to important institutional constraints (e.g. limited resources and capacity within district line agencies, limited human resources in the Secretariat), governance issues (e.g. deficiencies in fund management, conflicts among traders, poor accountability of CADF actors) and the diversion of its resources into activities that are not directly related to CA dissemination – see the collateral report on the governance of the CADF (Lestrelin 2015). As a result, the important contextual changes that have taken place after 2008 in the study area – i.e. diversified agricultural markets and facilitated access to agricultural machinery – have not been built on for disseminating CA on a broader scale.

5. Prospects for the EFICAS project

As suggested by the above results, supporting CA-based land use transition towards diversification and agroforestry in settings like southern Sayaboury Province requires not only relatively stable and diversified agricultural markets and adequate agri-input supply. It also requires strong commitment and sufficient human and financial resources allocated over a relatively long period of time in order to shape the overall agricultural industry – e.g. raising awareness, providing technical and organisational advice and support at the village level, structuring production and service provision groups, etc.

In these conditions and given its limited resources and primary focus on research, different prospects can be identified for the EFICAS project. In southern Sayaboury Province, EFICAS could provide valuable technical advices and methodological support to the CADF Secretariat, especially regarding its current endeavour to design and promote a renewed intervention strategy. Indeed, over the past two years, the Secretariat has been developing a proposal for a more integrated rural development approach focused on three pilot villages (Houaybouha in Kenthao district, Bouamlao-Phakeo and Ban Muangpa in Paklay district). With this approach, CADF funding would be managed directly by the Secretariat to support the organization and functioning of various occupational groups (i.e. not only "CA practitioners" but, depending on villagers' interest, other groups like "conventional maize producers", "pig farmers", "service providers for machinery", "cattle/buffalo

farmers", etc.). The EFICAS methodology, based on a more territorialized approach, could possibly be applied, or at least inspire some components of the CADF approach, in order to better link it to the landscape. EFICAS could notably provide technical advice and support to develop and promote innovative cropping systems that account for the current crop diversification trend, e.g. integrating maize, peanut, sesame and even cassava into CA and/or agro-forestry systems. In line with recent reconfigurations in the governance of the CADF (see Lestrelin 2015), a specific reflection could also be engaged on the institutional status, functioning and mandates of the CADF Secretariat. In turn, the Sayaboury experience should provide guidance for the implementation of the EFICAS project in its own target sites in Huaphanh, Phongsaly and Luang Prabang. In particular, given the geographical spread of the project (i.e. two districts in three different provinces), careful reflection should be engaged on human resource allocation and relations with local partners – especially DAFOs and extension agents – from the very outset of the activities as these have shown to play a determinant role in shaping the actual project success.

In terms of knowledge capitalization finally, better understanding and detailed characterization of local-to-regional agroecological transition pathways could be achieved by building on the 10-year historical dataset presented above and comparing with similar information collected in other settings (e.g. PAMPA project in Xieng Khouang, CIRAD activities in Cambodia) – which in turn could feed the research conducted by EFICAS and other similar projects focused on land-use innovation in the region. For scholars like Giller et al. (2009), CA is knowledge and capital-intensive and thus often incompatible with smallholder farming. As such, dissemination should concentrate on 'socio-ecological niches' (areas with e.g. soil erosion issues, good access to markets and inputs, smallholders with sufficient land, labour and capital) where CA is most likely to be adopted. As discussed above, studies on CA dissemination in Laos suggest also that, with adequate research and extension, CA can actually compete with less sustainable forms of agricultural intensification in a smallholder context and depending on key factors like market access, land degradation issues, etc. Thus, the concept of 'socio-ecological niche' can prove useful for characterizing areas where CA has most potentialities for adoption by smallholders. However, as argued by Lestrelin and Castella (2011: 43), "local socio-ecological systems are not just spatially diverse; they are highly dynamic and constantly reshaped by broader political, socioeconomic and biophysical driving forces. In that sense, rather than locating potential 'hotspots' for dissemination, the most important challenge for CA researchers and practitioners lies in identifying the key moments for intervention along specific agroecological transition pathways". In turn, this focus on transition pathways requires specific efforts for building, compiling and analyzing consistent historical datasets across different landscapes.

References cited

Coudray J, Pillot D. 2014. *Agro-écologie : évaluation de 15 ans d'actions d'accompagnement de l'AFD. Rapport de site visité: Laos*. GRET, Paris, 55 p.

Giller K, Witter E, Corbeels M, Tittonell P. 2009. Conservation agriculture and smallholder farming in Africa: The heretics' view. *Field Crops Research* 114:23-34.

Lestrelin G. 2006. *Rapport de mission d'appui : Suivi évaluation des adoptions 2006*. Programme National Agro-Ecologie, Vientiane, 71 p.

Lestrelin G. 2015. *Knowledge Capitalization on the Conservation Agriculture Development Fund in Sayaboury, 2008-2014*. EFICAS CA-NUDP project, Vientiane. Draft version, January 2015.

Lestrelin G, Castella J-C. 2011. Opportunities and challenges for the adoption of Conservation Agriculture in maize production areas of Laos. *In* ACIAR (Eds.), *Resilient food systems for a changing world: proceedings of the 5th world congress on conservation agriculture*, ACIAR, Brisbane, pp. 42-43.

Lestrelin G*, et al.* 2012. Conservation agriculture in Lao PDR: Diffusion and determinants for adoption of DMC systems in smallholder agriculture. *Renewable Agriculture and Food Systems* 27:81-92.

Saioudom L. 2008. *Risques sanitaires liés aux pesticides chez les agriculteurs, province de Xayaboury, Laos*. Master's dissertation. Institut de la francophonie pour la médecine tropicale (IFMT), Vientiane.

Slaats J, Lestrelin G. 2009. *Improving cropping systems by introducing Conservation Agriculture: Taking stock of the results and methodology of research-development in southern Sayaboury province, Lao PDR*. PCADR, Vientiane, 115 p.

Tran Quoc H, Chanthavong S, Chayvanna S, Ingthavong X, Ingthavong S. 2004. *Caractérisation des systèmes de production dans 4 villages du sud de la province de Sayaboury*. Programme National Agro-Ecologie, Vientiane, 26 p.

Appendix 1: Additional Tables and Figures

Table 11. Evolution of poverty in the study villages (% of poor households, 2004-2013)

	2004	2007	2013
Boten District	**37,1%**	**8,1%**	**11,1%**
Khonken (Boten)	52,8%	9,2%	3,3%
Mayphonexay	30,1%	2,4%	20,0%
Nabong tay	43,5%	6,5%	6,7%
Nakok	25,8%	4,6%	20,0%
Nongphakbong	41,1%	10,8%	3,3%
Thanang	37,0%	17,4%	13,3%
Kenthao District	**29,6%**	**5,4%**	**11,1%**
Houaybouha	17,2%	1,7%	3,3%
Houayleuk	32,2%	13,2%	13,3%
Houaylod	40,0%	2,6%	16,7%
Houayped	48,0%	6,8%	30,0%
Paktom neua	13,9%	1,8%	3,3%
Vangpa	27,0%	3,1%	0,0%
Paklay District	**9,1%**	**1,4%**	**12,8%**
Bouamlao	3,3%	0,8%	10,0%
Kengsao	13,1%	4,3%	26,7%
Khonken (Paklay)	4,1%	1,5%	10,0%
Namgnang	15,4%	0,0%	10,0%
Phakeo	11,9%	2,0%	6,7%
Senphone	6,3%	0,0%	13,3%
Thongmixay District	**63,7%**	**35,9%**	**6,7%**
Dane	54,6%	38,8%	3,3%
May	67,0%	38,4%	16,7%
Namon	70,9%	29,6%	0,0%
Total 4 districts	**28,9%**	**8,7%**	**11,0%**

Using the national poverty line of	***2004***	***2010***	***2013***
LAK/person/year	*1 704 000*	*2 160 000*	*3 036 000*
THB/person/year	*6 700*	*8 200*	*12 000*

Figure 21. Distribution of the annual household incomes in Boten district (2004-2007-2014)

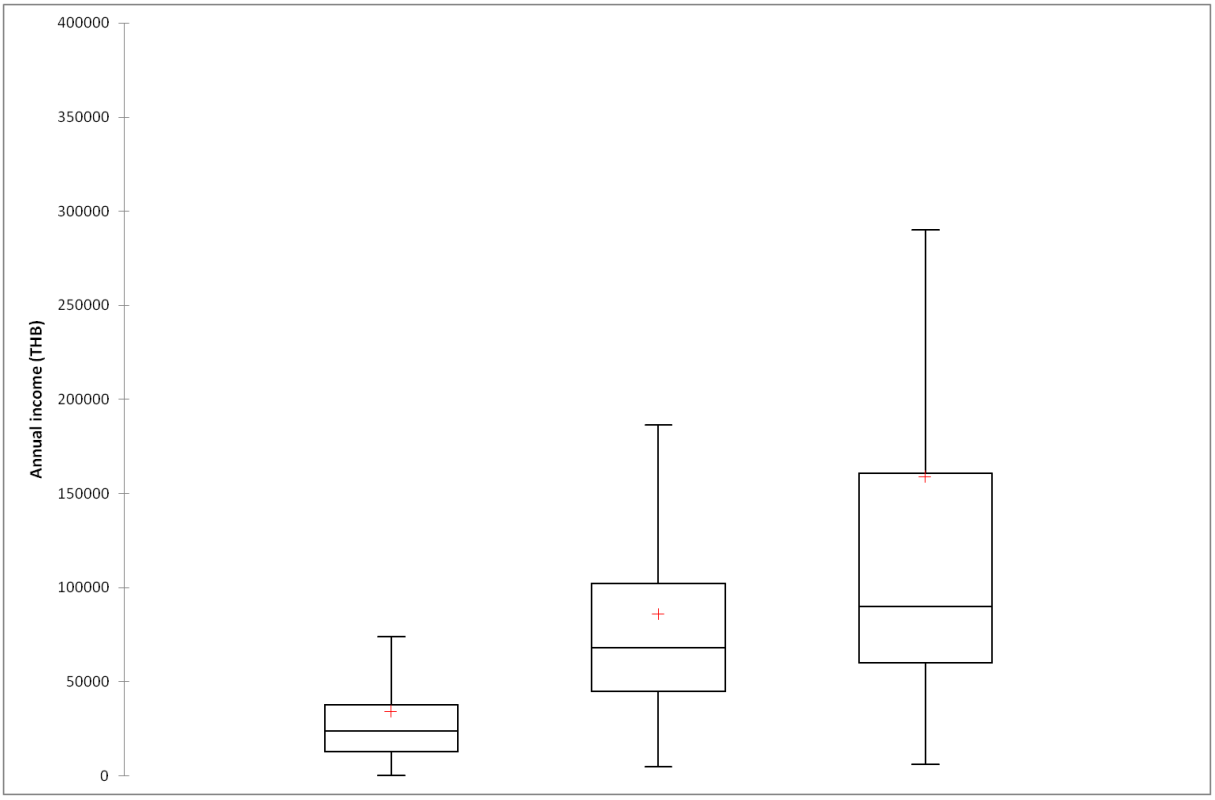


Figure 22. Distribution of the annual household incomes in Kenthao district (2004-2007-2014)

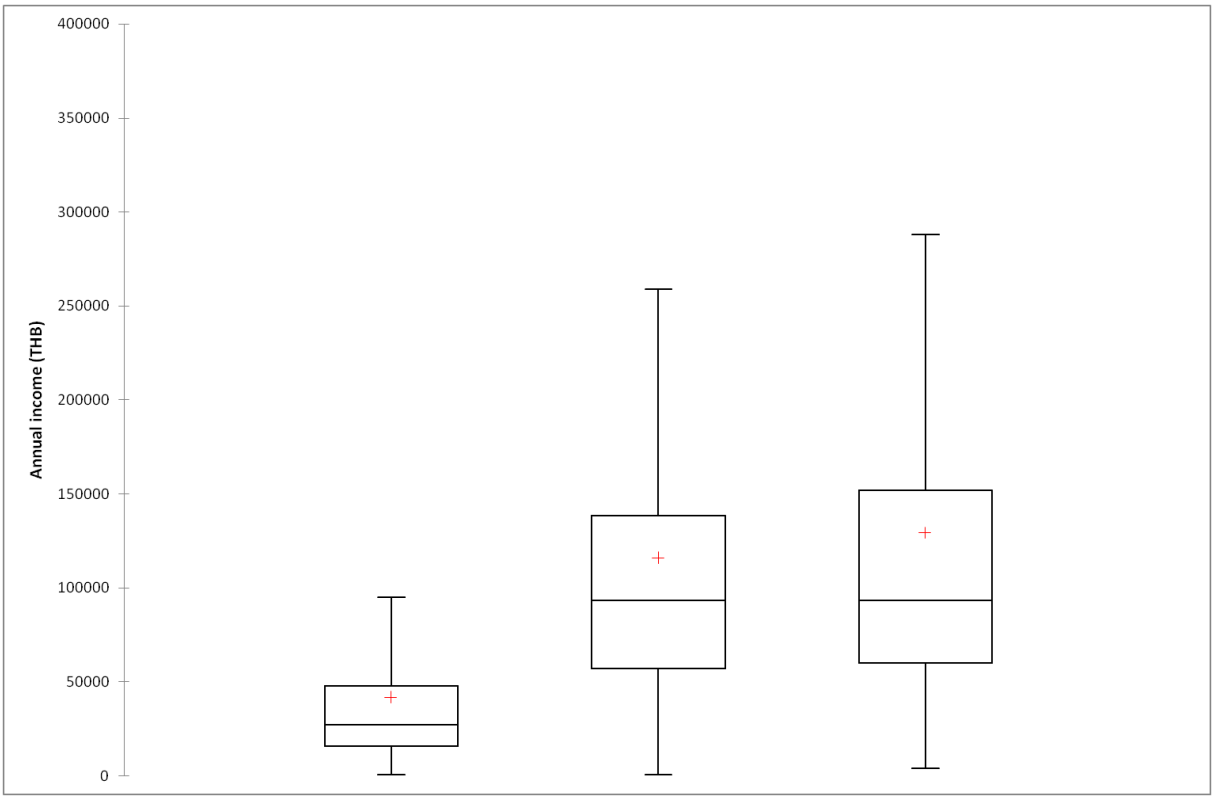


Figure 23. Distribution of the annual household incomes in Paklay district (2004-2007-2014)

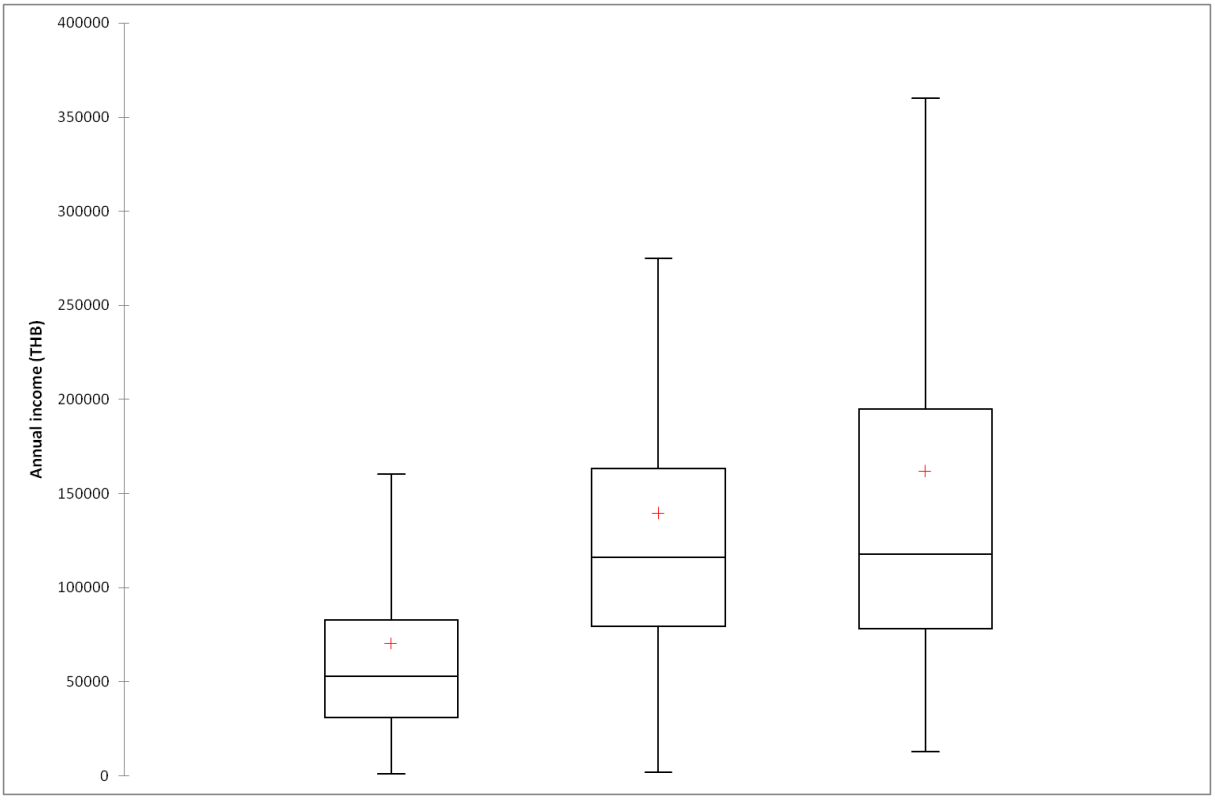


Figure 24. Distribution of the annual household incomes in Thongmixay district (2004-2007-2014)

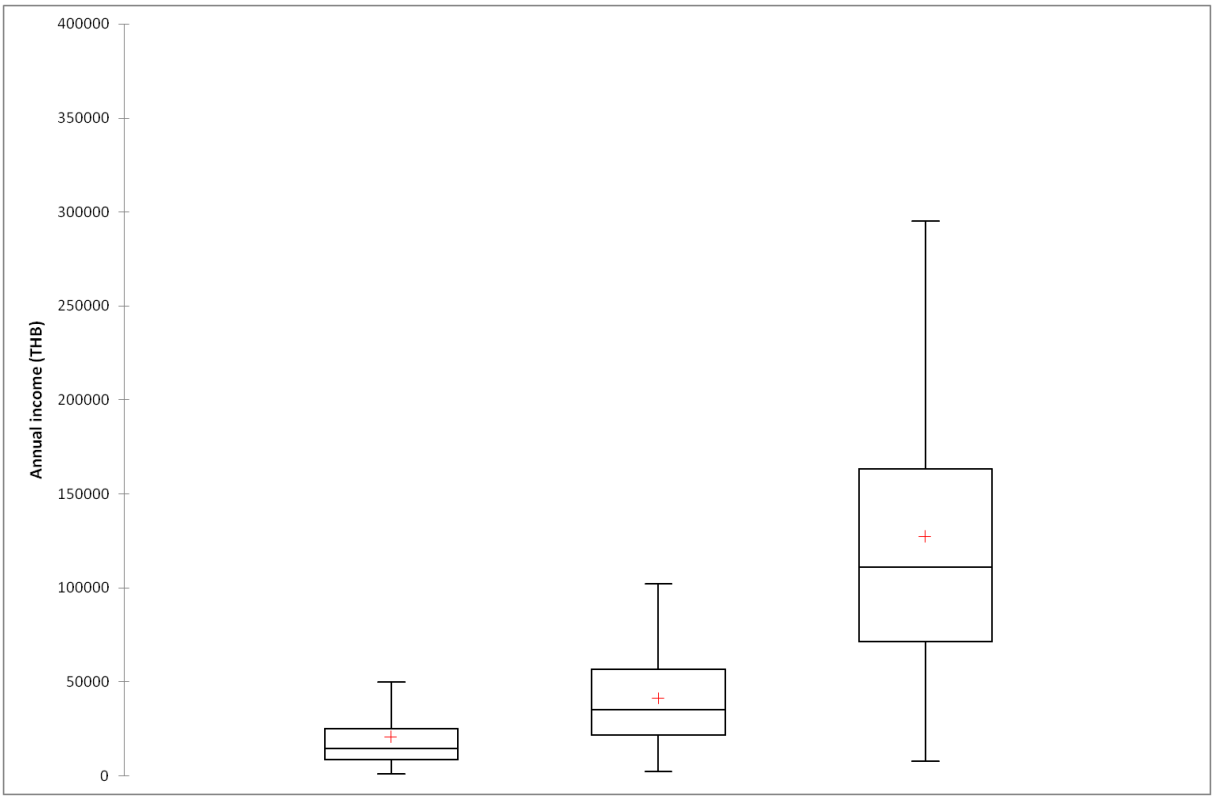


Table 12. Access to paddy land (percent of village households, 2005-2014)

		2005	2008	2014
Boten District	Khonken (Boten)	92%	86%	87%
	Mayphonexay	73%	78%	80%
	Nabong tay	84%	73%	100%
	Nakok	97%	94%	80%
	Nongphakbong	97%	96%	93%
	Thanang	96%	97%	97%
Kenthao District	Houaybouha	73%	81%	90%
	Houayleuk	71%	71%	67%
	Houaylod	62%	73%	80%
	Houayped	72%	78%	87%
	Paktom neua	81%	87%	80%
	Vangpa	71%	60%	90%
Paklay District	Bouamlao	57%	58%	60%
	Kengsao	56%	54%	73%
	Khonken (Paklay)	79%	81%	80%
	Namgnang	78%	93%	77%
	Phakeo	75%	76%	83%
	Senphone	76%	75%	70%
Thongmixay District	Dane	94%	90%	97%
	May	88%	92%	87%
	Namon	86%	80%	87%

Table 13. Average paddy land cultivated (hectares per household, 2005-2014)

		2005	2008	2014
Boten District	Khonken (Boten)	0,65	0,71	0,81
	Mayphonexay	0,55	0,52	0,68
	Nabong tay	0,75	0,83	0,67
	Nakok	0,86	0,89	1,00
	Nongphakbong	0,73	0,70	0,93
	Thanang	0,67	0,79	1,01
Kenthao District	Houaybouha	0,57	0,56	0,70
	Houayleuk	0,48	0,45	0,49
	Houaylod	0,63	0,57	0,59
	Houayped	0,51	0,51	0,36
	Paktom neua	0,54	0,50	0,61
	Vangpa	0,48	0,47	0,61
Paklay District	Bouamlao	0,45	0,46	0,51
	Kengsao	0,56	0,62	0,61
	Khonken (Paklay)	0,63	0,56	0,55
	Namgnang	0,65	0,79	0,75
	Phakeo	0,57	0,51	0,61
	Senphone	0,65	0,55	0,63
Thongmixay District	Dane	0,64	0,66	0,41
	May	1,01	0,87	1,02
	Namon	0,71	0,65	0,55

Table 14. Estimated total surface areas of upland crops in villages of Boten district (hectares, 2014)[4]

	Khonken (Boten)	Mayphonexay	Nabong tay	Nakok	Nongphakbong	Thanang
Maize	277	372	4	112	26	45
Job's Tears	5	-	-	-	-	1
Rainfed rice	10	27	1	-	4	-
Peanut	-	1	-	3	15	10
Sesame	10	3	31	-	69	23
Vigna	5	5	2	-	52	28
Cassava	-	150	-	4	92	52
Teak	-	2	1	10	-	-
Rubber	-	24	-	-	8	-
Pasture	15	61	8	30	216	38
Total	**321**	**644**	**46**	**158**	**481**	**198**

Table 15. Estimated total surface areas of upland crops in villages of Kenthao district (hectares, 2014)[4]

	Houaybouha	Houayleuk	Houaylod	Houayped	Paktom	Vangpa
Maize	1134	677	414	371	869	1152
Job's Tears	-	-	84	41	-	-
Rainfed rice	14	55	-	10	66	27
Peanut	60	19	-	-	39	36
Sesame	-	-	5	-	-	-
Vigna	16	1	-	-	51	-
Cassava	28	-	119	29	218	4
Teak	7	25	30	-	-	11
Rubber	-	-	-	-	-	-
Pasture	81	25	96	22	122	61
Total	**1341**	**803**	**748**	**473**	**1364**	**1290**

Table 16. Estimated total surface areas of upland crops in villages of Paklay district (hectares, 2014)[4]

	Bouamlao	Kengsao	Khonken (Paklay)	Namgnang	Phakeo	Senphone
Maize	1004	366	972	1201	1377	369
Job's Tears	23	-	1	4	22	1
Rainfed rice	32	3	18	53	24	5
Peanut	117	-	30	33	109	24
Sesame	-	-	-	-	-	-
Vigna	21	-	3	3	-	3
Cassava	8	37	34	13	23	44
Teak	8	37	8	14	53	7
Rubber	100	-	1	1	-	-
Pasture	46	72	96	143	85	20
Total	**1358**	**515**	**1166**	**1465**	**1693**	**473**

[4] Village level estimates are calculated using the values reported by our 30 household samples proportioned to the actual population of the villages.

Table 17. Estimated total surface areas of upland crops in villages of Thongmixay district (hectares, 2014)[4]

	Dane	May	Namon
Maize	-	11	25
Job's Tears	168	468	239
Rainfed rice	-	-	3
Peanut	-	-	-
Sesame	-	-	-
Vigna	-	-	-
Cassava	-	-	-
Teak	-	29	-
Rubber	-	-	-
Pasture	24	34	-
Total	**192**	**542**	**266**

Table 18. Villagers using service providers for herbicide application (% of households, 2005-2014)

	2005	**2008**	**2104**
Boten	1%	6%	5%
Kenthao	8%	14%	16%
Paklay	18%	20%	19%
Thongmixay	0%	13%	20%
Total	**9%**	**14%**	**14%**

Table 19. Main herbicides used (relative frequency of use, 2005-2014)

		2005	2008	2014
Boten	2,4 D	2%	3%	3%
	Atrazine	4%	37%	17%
	Glyphosate	85%	41%	60%
	Gramoxone	9%	15%	20%
Kenthao	2,4 D	3%	1%	2%
	Atrazine	28%	46%	36%
	Glyphosate	49%	25%	40%
	Gramoxone	20%	27%	22%
Paklay	2,4 D	5%	2%	1%
	Atrazine	53%	47%	22%
	Glyphosate	5%	18%	43%
	Gramoxone	36%	33%	34%
Thongmixay	2,4 D	0%	0%	0%
	Atrazine	0%	44%	37%
	Glyphosate	0%	37%	50%
	Gramoxone	0%	15%	13%

Table 20. Villagers engaged in cattle/buffalo raising (% of households, 2005-2014)

		2005	2008	2014
Boten District	Khonken (Boten)	84%	78%	30%
	Mayphonexay	50%	43%	53%
	Nabong tay	71%	79%	57%
	Nakok	73%	70%	50%
	Nongphakbong	84%	42%	83%
	Thanang	79%	53%	80%
Kenthao District	Houaybouha	74%	19%	3%
	Houayleuk	79%	75%	43%
	Houaylod	53%	53%	43%
	Houayped	60%	54%	17%
	Paktom neua	40%	16%	17%
	Vangpa	94%	71%	57%
Paklay District	Bouamlao	38%	45%	23%
	Kengsao	54%	66%	73%
	Khonken (Paklay)	40%	51%	43%
	Namgnang	75%	60%	43%
	Phakeo	20%	21%	57%
	Senphone	44%	42%	43%
Thongmixay District	Dane	51%	53%	63%
	May	66%	77%	57%
	Namon	52%	58%	67%

Table 21. Villagers engaged in pig raising (% of households, 2005-2014)

		2005	2008	2014
Boten District	Khonken (Boten)	87%	38%	37%
	Mayphonexay	24%	2%	13%
	Nabong tay	92%	77%	87%
	Nakok	59%	24%	10%
	Nongphakbong	55%	33%	63%
	Thanang	77%	14%	23%
Kenthao District	Houaybouha	62%	34%	13%
	Houayleuk	36%	13%	23%
	Houaylod	31%	18%	20%
	Houayped	16%	12%	7%
	Paktom neua	29%	11%	23%
	Vangpa	67%	51%	33%
Paklay District	Bouamlao	59%	23%	17%
	Kengsao	37%	8%	23%
	Khonken (Paklay)	74%	51%	40%
	Namgnang	77%	77%	80%
	Phakeo	64%	38%	27%
	Senphone	56%	29%	17%
Thongmixay District	Dane	91%	38%	30%
	May	93%	76%	80%
	Namon	100%	82%	90%

Figure 25. Maize trading price at the Thai border, 2005-2013 (Source: CADF dataset)

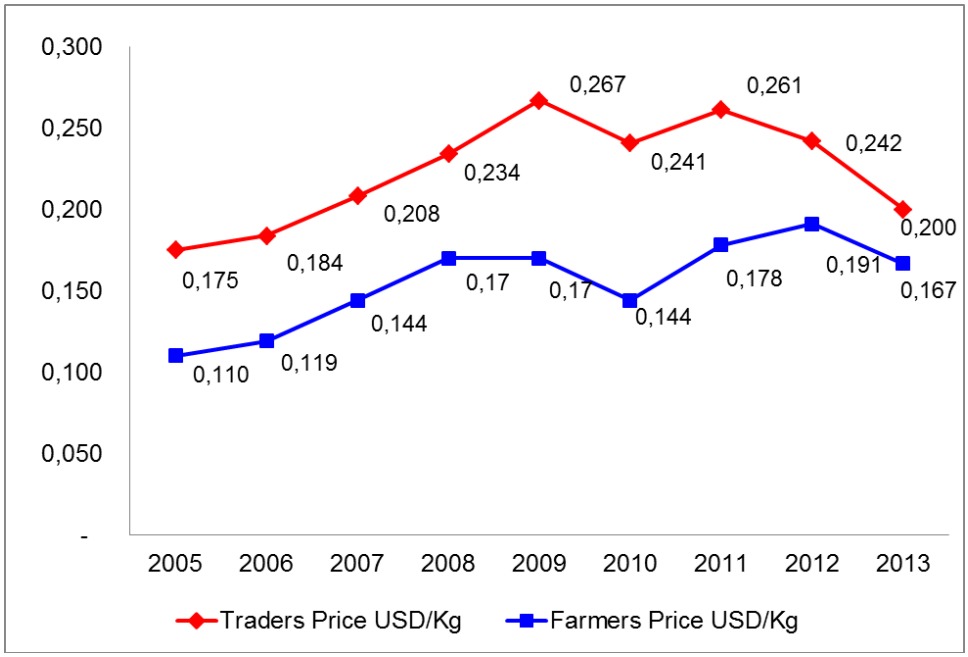


Table 22. Pearson correlation matrix on key variables in 2014 (significant correlations at the 0.01 level are underlined)

Variables	Farm labour	Agricultural Income	Off/non-farm Income	Diversity Rainfed Crops	SA Job's Tear	SA perennial, cassava & peanut	Herbicide use	SA in DMC	SA land sales
Farm labour	**1**	**0,450**	**0,139**	**0,710**	-0,070	**0,457**	**0,202**	**0,118**	0,072
Agricultural Income	**0,450**	**1**	**0,156**	**0,587**	0,031	**0,432**	**0,296**	0,075	0,019
Off/non-farm Income	**0,139**	**0,156**	**1**	**0,126**	-0,067	**0,236**	**-0,123**	-0,007	-0,001
Diversity Rainfed Crops	**0,710**	**0,587**	**0,126**	**1**	-0,058	**0,527**	**0,294**	**0,221**	0,016
SA Job's Tear	-0,070	0,031	-0,067	-0,058	**1**	-0,062	0,084	**0,300**	-0,035
SA perennial, cassava & peanut	**0,457**	**0,432**	**0,236**	**0,527**	-0,062	**1**	0,083	0,028	0,071
Herbicide use	**0,202**	**0,296**	**-0,123**	**0,294**	0,084	0,083	**1**	**0,287**	0,017
SA in DMC	**0,118**	0,075	-0,007	**0,221**	**0,300**	0,028	**0,287**	**1**	0,001
SA land sales	0,072	0,019	-0,001	0,016	-0,035	0,071	0,017	0,001	**1**

Table 23. Land preparation types per crop (frequency of use, 2014)

	DMC	Slash/Burn	Tillage
Maize	13%	2%	85%
Rainfed rice	9%	29%	62%
Job's tear	38%	29%	33%
Peanut	6%	16%	79%
Vigna	64%	13%	23%
Sesame	43%	21%	36%
Cassava	1%	2%	97%
Pasture	0%	30%	70%
Rubber	0%	14%	86%
Teak	0%	84%	16%

Table 24. Estimated total surface areas of upland crops per land preparation type in villages of Boten district (hectares, 2014)[5]

	Khonken (Boten)	Mayphonexay	Nabong tay	Nakok	Nongphakbong	Thanang
DMC	47	13	1	-	118	46
Slash & Burn	7	12	8	7	7	7
Tillage	253	532	29	112	132	106
Total	**306**	**557**	**37**	**119**	**257**	**159**

Boten district: 225 ha DMC / 1435 ha = 15.7 %

Table 25. Estimated total surface areas of upland crops per land preparation type in villages of Kenthao district (hectares, 2014)[5]

	Houaybouha	Houayleuk	Houaylod	Houayped	Paktom	Vangpa
DMC	112	65	165	34	146	53
Slash & Burn	19	35	10	24	24	11
Tillage	1151	653	446	393	1073	1154
Total	**1281**	**753**	**622**	**451**	**1242**	**1218**

Kenthao district: 575 ha DMC / 5567 ha = 10.3 %

Table 26. Estimated total surface areas of upland crops per land preparation type in villages of Paklay district (hectares, 2014) [5]

	Bouamlao	Kengsao	Khonken (Paklay)	Namgnang	Phakeo	Senphone
DMC	52	4	93	45	10	32
Slash & Burn	38	20	22	20	69	5
Tillage	1113	383	946	1243	1476	407
Total	**1204**	**407**	**1060**	**1307**	**1555**	**445**

Paklay district: 236 ha DMC / 5978 ha = 4 %

Table 27. Estimated total surface areas of upland crops per land preparation type in villages of Thongmixay district (hectares, 2014) [5]

	Dane	May	Namon
DMC	19	244	142
Slash & Burn	52	105	46
Tillage	98	130	78
Total	**168**	**480**	**266**

Thongmixay district: 405 ha DMC /914 ha = 44.3 %

[5] Village level estimates are calculated using the values reported by our 30 household samples proportioned to the actual population of the villages.

Appendix 2: Terms of Reference

Rationale

The objective of the study is to provide an up-to-date overview of the status of Conservation Agriculture (CA) in the four southern district of Sayaboury Province. The work will build upon and update the observations made by previous studies (i.e. Slaats and Lestrelin 2009; Coudray and Pillot 2014).

Expected outputs and products

1. A research report providing up-to-date information and analysis on the situation of CA (e.g. extent of dissemination, cropping systems involved, local technical or organizational adaptations), the main recent agricultural and land use changes and the main drivers for these changes in villages targeted by the PRONAE and PASS projects between 2005 and 2008
2. An adapted/updated version of the database developed by the PASS project

Partners involved

- EFICAS DALaM team
- Sayaboury CADF team
- Technicians from Boten, Kenthao, Paklay and Thongmixay DAFOs
- Guillaume Lestrelin as an external consultant to implement the study, including coordination with the Sayaboury Fund and DAFO teams (Guillaume was involved in the 2009 study and is in possession of the latest versions of the PASS and PRONAE databases)

Schedule
Preparation of the study: 4 days, distributed between November 3-14
Fieldwork and data keying: 25 days, from mid November to mid December
Data analysis and reporting: before the end of January 2015

Methods

Questionnaire surveys will be conducted in the 21 villages monitored by the PASS project in Boten, Kenthao, Paklay and Thongmixay districts between 2005 and 2008 and in 3 additional villages of Thongmixay district with relatively important surface areas in CA as reported by the DAFO in 2012:

Boten district	**Kenthao district**	**Paklay district**	**Thongmixay district**
Khonken	Houaybouha	Bouamlao	Dane
Mayphonexay	Houayleuk	Kengsao	May
Nabong tay	Houaylod	Khonken	Namon
Nakok	Houayped	Namgnang	
Nongphakbong	Paktom neua	Phakeo	
Thanang	Vangpa	Senphone	

The surveys will build on:
- 30 random household samples in each target village (i.e. a total of 630 interviewees)
- A questionnaire similar to the one used by PASS (for broad compatibility with the existing database structure) yet adapted to reflect recent contextual changes and emerging questions on land use changes and local adaptations of cropping and production systems.

Respective responsibilities will be described in the contract to be signed between the two parties, i.e. Eficas-NUDP-CA project unit as the contracting authority and Dr Guillaume Lestrelin as the external consultant.