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vam
vulnerability analysis and mapping

Lao PDR

District Vulnerability Analysis – 2005 Update

Secondary Data Analysis

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I. Background and Introduction

Lao PDR is a least developed country characterized by very poor human development indicators. The majority of households in rural areas are subsistence cultivators. The recent Lao National Growth and Poverty Eradication Strategy (2004) policies identified household food insecurity as the most critical challenge to overcome in order to ensure the most basic level of secure and sustainable livelihoods for the majority of the Lao rural population. It is estimated that under normal conditions over one third of the population experiences rice shortfalls of two to six months per year. Chronic malnutrition is high, affecting up to 47% of children under 5 years of age, particularly in rural areas. However, detailed national information on vulnerability and food security at the household level is still unavailable.

With a subsistence economy, rather than a market/cash economy, natural hazards, changing weather and climate conditions, environmental degradation, economic reforms, etc. often have serious negative consequences on household food security, eroding an already tenuous household livelihood situation. Many recent poverty studies identify the need to obtain sufficient food as the key worry for most rural families.

When looking at the vulnerability to food security situation in Lao PDR, it is important to define several concepts. At the 1996 World Food Summit it was agreed that **food security** exists when:

> "all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."

This definition of food insecurity incorporates three dimensions or elements (WFP, Emergency Food Security Assessment Handbook, 2004):

- **Food Availability** is the amount of food that is physically present in a country or area through all forms of domestic production, commercial imports and food aid.
- **Food Access** is a household's ability to regularly acquire adequate amounts of food through a combination of their own stock and home production, purchases, barter, gifts, borrowing or food aid.
- **Biological Utilization of Food** refers to: (a) households' use of the food to which they have access, and (b) individuals' ability to absorb nutrients – the conversion efficiency of food by the body.

The term food security (defined above) describes a condition at a given point in time. By contrast, the term vulnerability is used to describe the level of risk for future food insecurity. The United Nations Food and Agricultural Organization (FAO) Food Insecurity and Vulnerability Information and Mapping System (FIVIMS) defines **vulnerability** as:

> "the full range of factors that place people at risk of becoming food-insecure. The degree of vulnerability of individuals, households or groups of people is determined by their exposure to the risk factors and their ability to cope with or withstand stressful situations."

In the World Food Programme context, and in this report, the term vulnerability refers to vulnerability to food insecurity specifically.

Recent studies on vulnerability suggest that the concept can be expanded to capture a more complex relationship between risks, ability to cope, and actions taken before, during and after shocks that affect food security. Vulnerability, when viewed in relation to the probability of experiencing welfare loss caused by uncertain events, not only depends on exposure to risks and the ability to cope with and withstand stressful situations, but also on the ability to reduce risks before a shock occurs (proactive) and respond effectively during and after shocks occur (reactive). Not surprisingly, poor people tend to be more vulnerable because they have fewer means, resources and options to respond proactively to reduce risks and respond reactively once shocks occur.

It is important to recognize that, although often related, the terms **poverty** and **food insecurity** describe different conditions that may have different causes. A common assumption is that addressing poverty will reduce vulnerability to future food insecurity or alleviate current food insecurity. Despite often being true, this relationship between poverty, vulnerability, and food insecurity is not always direct (i.e. cause and effect) as income poverty does not always result in reduced food availability or access and, therefore, not all poor are food insecure.

The WFP VAM (Vulnerability Analysis and Mapping) approach to food security and vulnerability analysis incorporates five guiding questions with the aim of providing decision makers with the information they need to design appropriate programmatic responses.

- Who are the food insecure?
- How many are they?
- Where do they live?
- Why are they food insecure?
- Does food aid have a role to play?

In an attempt to address these questions and thus provide a better basis for geographic targeting of its food assistance interventions, WFP Laos has undertaken in previous years secondary data analysis of indicators assumed to be related to vulnerability to food insecurity in the context of Lao PDR. These analyses have resulted in the creation of composite indicators or indices to measure and map vulnerability.

This *Lao PDR District Vulnerability Analysis – 2005 Update* presents a composite vulnerability indicator, or index, as done in previous years, by providing an update and simple summary of the informally distributed report *2004 District Vulnerability Analysis: Laos*. A composite indicator has the advantage of being simple to understand and compare to other linear indicators. The addition of a cluster analysis at the district level adds another dimension to the analysis by describing groups of districts with similar vulnerability characteristics.[1] Both analyses have the potential to mask small pockets of increased or lessened vulnerability within districts. Additionally, with a lack of household level data that comes from a comprehensive food security and vulnerability survey, and no solid outcome indicators such as food consumption or nutritional status that more directly measure food security, some of the key VAM questions related to food security and vulnerability remain to be answered.

II. Indicators

Eight indicators were chosen to be included in the analysis. These indicators were selected based on several criteria:

- Potential relationship of the indicator to vulnerability to food insecurity.
- Non-duplication of information between indicators.
- Availability of reliable and timely data at the district level for all (or most) districts in the country.
- Consensus with government bodies and other development agencies as to the relevance of the data.

It is important to emphasize that these indicators are assumed to be related to vulnerability, but as no outcome variable is available at the district level to test this assumption, this is a subjective analysis based on WFP experience globally and in Lao PDR. Additionally, there are many other factors related to vulnerability that are not accounted for in the analysis, due to unreliable, incomplete, or non-existent data. The results, therefore, should be viewed in this light.

[1] The proposed modifications are based upon VAM methodologies as described in the 2005 'VAM Thematic Guidelines - Household Food Security Profiles', WFP Rome.

Table 1 lists all eight indicators used for the analysis, the values for all districts for each of these indicators are presented in Annex II.

Table 1: List of indicators

Indicator	Data source	Definition/Formula
Rice Production (wet season & dry season) per Capita	Agricultural Census 98/99, Provincial Rice Production Statistics 2000-2001	This indicator was calculated as: (Dry season planted area in ha * yield in t/ha + wet season planted area in ha * yield in t/ha) * 60% milling recovery rate from paddy to rice / population in 2003
Cropping Diversity (major crop classes)	Agricultural Census 98/99, Provincial Rice Production Statistics 2000-2001	Crop Diversity was derived from the main agricultural cropping classes in Laos, where the planted area in hectares of the individual crop classes were added to form the variable (in the absence of information on individual crop yields)
Livestock Ownership (cattle, buffaloes, pigs, chicken and ducks) per Household	Agricultural Census 98/99	This indicator was weighted and calculated as: Buffalo + Cattle + 0.75 * Pigs + 0.10 * Chicken & Ducks
Access to Forested Areas (and Non-Timber-Forest-Products) per Household (NTFP)	Mekong River Commission 97/98	In this analysis, forest cover classes 11 (Evergreen, high cover density) & 61 (Wood – shrub land, evergreen) were combined and an average value per village was extracted to represent village level access to forest
Access to Roads and Rivers (markets and services)	Department of Construction, Post, Transport and Communications, 2002	These indicators were first derived independently and then combined to form one indicator. Access = Roads + 0.5 * Rivers Roads: the distances to national and secondary roads were calculated for all villages and the final indicator was calculated as follows: Roads = Main Roads + 0.5 * Secondary Roads Rivers: the distances to all major rivers were calculated for all villages in Laos
Malaria Incidence	Center for Malariology, Parasitology and Entomology, 2002	This indicator was determined as the number of reported cases of malaria in 2002 divided by population. Note: in 16 districts, data was unavailable (noted in the table in Annex II). In these cases, the mean incidence of malaria in the province was used in the analysis
Unexploded Ordnance (UXO) Impact	UXO Laos 2002	This indicator was calculated as level of impact (High = 8, Moderate = 4, Low = 2 and all other = 0) and then the indicator was converted into a continuous variable
Incidence of no or low Education	Population Census 1995	This indicator was calculated as the percent of household heads that have never been to school or finished Grade 1

III. Principal Component Analysis and the Creation of a Composite Indicator

In order to create one composite indicator from the eight indicators included in the analysis, a principal component analysis (PCA) was run. Principal component analysis explains the variation within and among all eight indicators by creating new, independent indicators, or components. Each component is a continuous variable.

PCA is essentially a process of data reduction. A series of variables measuring a particular category of behavior are optimized into principal components capturing the essence of the relationships among initial variables of this behavior. Each principal component is thus a new indicator that represents the "best" summary of the linear relationship among the initial variables.

PCA yields as many principal components as there are initial variables. However, the contribution of each principal component in explaining the total variance found amongst districts progressively decreases from the first principal component to the last.

The first component, which explains the greatest portion of the variation in the original eight indicators, is used here as the composite indicator of vulnerability. This composite vulnerability indicator describes 30% of the variation in the original data. For each of the original variables, just a part of the variance is explained by the first principal component. This is summarized in Table 2, below. The first principal component is made up primarily by the variables rice production, livestock ownership, distance to roads/rivers, and incidence of no or low education. (The other variables are not as fully accounted for in the first principal component because the original variables do not share a high degree of correlation among themselves)

Table 2: Relationship of the first principal component (composite vulnerability index) to the original variables.

Indicator	% of original variable (indicator) extracted by the 1st principal component
Rice production per capita	45%
Cropping diversity	5%
Livestock ownership	52%
Access to forested areas	15%
Access to roads and rivers	35%
Malaria incidence	<1%
UXO impact	17%
Incidence of no or low education	64%

Extraction Method: Principal Component Analysis.

When looking at the correlation of the composite vulnerability indicator to the 8 variables included in the analysis, an INCREASE[2] in the composite indicator is associated with a:

- DECREASE in rice production per capita (r=-0.67**)
- DECREASE in cropping diversity (r= -0.23**)
- DECREASE in livestock ownership (r= -0.72**)
- INCREASE in access to forested area (r= 0.39**)
- INCREASE in distance of villages from roads/rivers (r= 0.59**)
- DECREASE in incidence of malaria (r= -0.05 not significant at the 0.05 level)
- INCREASE in UXO impact (r= 0.41**)
- INCREASE in percent of household heads with no or low education (r= 0.80**)

It is important to note here that there is no significant relationship between the incidence of malaria and the composite vulnerability indicator. Additionally, a higher level of the composite vulnerability indicator is associated with a better access to forested areas. This may indicate that, although poorer access to forest areas may be associated with greater vulnerability, the districts that appear more vulnerable by the other indicators lie in areas with greater access to forested area. Alternatively, better access to forested area may in fact be related to greater vulnerability, but the relationship is not illustrated in the first component.

To create four vulnerability typologies based on the vulnerability composite indicator, 25% of districts are placed in one of four categories (Very Vulnerable, Vulnerable, Medium,

[2] INCREASE and DECREASE here do not refer to cause and effect, or to a temporal effect, but simply a direction of the relationship (correlation) between the variables.
** Spearman correlation p-value <.001

Better Off). These cutoffs are subjectively placed, and the categories should be interpreted as such. The district level Composite Vulnerability Indicator map (Map 1) displaying these four categories is included in Annex I.

The strengths of this analysis include:

- A single composite indicator is simple to understand and display.
- This indicator is readily comparable to other analyses, such as the Lao Expenditure and Consumption Survey (LECS) III percent of households below the poverty line, and the National Growth and Poverty Eradication Strategy (2004) identified priority districts.

The weaknesses of this analysis include:

- The creation of an index does not provide an objective benchmark to delineate the vulnerable from those who are not vulnerable; the cut-offs used to group the districts into the four vulnerability categories are subjective.
- The use of an index does not provide analytic leverage for understanding the underlying causes of vulnerability.
- Without any outcome variable for vulnerability, the relationship of the composite indicator to vulnerability can only be assumed. In addition, due to the low levels of correlation between the original indicators, creating a single index using PCA is problematic. Only 30% of the variation in the original data is captured in the index when using just the first principal component.
- A district level analysis can hide smaller pockets of higher or lower vulnerability to food insecurity.

IV. Cluster Analysis and Creation of District Level Typologies

To further explore the data, a cluster analysis was conducted. This analysis uses all eight principal components created in the analysis described in Section III as input, and groups districts based on the similarities of these components, creating categories of districts that are similar in their levels of the eight original indicators.

The purpose of using principal component analysis (PCA) before cluster analysis is to describe districts on the basis of the relationships among selected variables. PCA is also necessary to standardize the scales of the original indicators before clustering districts. Under this approach, data reduction is a secondary objective. In order to capture a significant part of the relationship among variables, all eight principal components have been saved and provided as input for the clustering.

This allows for a fuller description of the characteristics of clustered districts, and does not rely on the consolidation of the variety of data into one composite indicator. However, as districts are clustered into the best fitting cluster, and the number of clusters must be limited to allow interpretation, it is possible to have districts that are a good fit in their category for all but one or two of the indicators – so these results are not necessarily definitive across a cluster for all districts and all indicators.

The cluster analysis describes 7 distinct clusters, sufficient to provide relatively homogeneous clusters, without exceeding a number of clusters that would encumber interpretation. These clusters are described in Table 3 below, and displayed in a district level map (Map 2) in Annex I. Green indicates a presumed lower level of vulnerability, as compared to the national average. Yellow indicates a value similar to that of the national average. Red indicates a presumed higher level of vulnerability. This classification is drawn on subjective lines, based on the distribution of the data. Low, average, and high refer to the relationship of the numerical value to the average of all districts. The raw cluster-level results that are summarized here are presented in Annex III.

Table 3: Description of clusters

Cluster	1	2	3	4	5	6	7
Rice production per capita	Low	High	Low	Low	Average	Low	High
Cropping diversity	Average	Average	Low	Low	Low	High	Average
Livestock ownership	Average	High	Low	Low	High	Average	Average
Access to forested areas	Low	Average	Average	High	High	Low	Low
Access to roads and rivers	High	High	Low	Low	Low	High	High
Malaria incidence	Low	High	Low	High	Low	Low	High
UXO impact	Low	Low	Low	High	High	Average	High
Incidence of no or low education	Low	Low	High	High	Average	Average	High

Strengths of this analysis:

- The information in the original eight indicators is preserved.
- Assumptions are not made in the analysis about the relationship of the indicators to vulnerability.
- Information about each of the individual indicators for the clusters can lead to appropriate project design and geographic targeting.

Weaknesses of this analysis:

- Multiple clusters and lack of a simple two dimensional indicator make interpretation more difficult.
- Without any outcome variable indicating vulnerability, the relationship of the clusters to vulnerability can only be assumed.
- A district level analysis can hide smaller pockets of higher or lower vulnerability to food insecurity.

V. Conclusion and Recommendations

With regard to WFP targeting, a combination of the information from both the principle component analysis (PCA) and the cluster analysis is considered. Additionally, it should be emphasized that this analysis is based on incomplete vulnerability data, as well as older datasets. Analysis at the district level can also hide pockets of vulnerability even within areas that appear to be the least vulnerable, as well as areas of relatively low vulnerability even within areas identified as highly vulnerable.

This analysis provides guidance to programming. It is recommended that programmes be concentrated in the districts grouped in the cluster analysis which have levels of the eight original indicators indicating increased vulnerability. The vulnerability composite index serves as a guide to relative levels of vulnerability between districts. Additional information as to the best way of delivering programming can be further inferred from the cluster analysis.

The geographic distribution of the districts determined to be more vulnerable to food insecurity as described by the composite indicator is similar to the distribution of clusters 3 and 4 in the cluster analysis. These two clusters show very similar patterns in the original eight indicators, with low rice production, low cropping diversity, low levels of livestock ownership, average to high access to forested areas, and low education. Cluster 4, however, also shows higher malaria prevalence and higher UXO contamination. These districts are located in lowland areas that were heavily bombed in the war. Cluster 3 is composed of districts with more mountainous areas and therefore lower malaria incidence; these are also areas that were not as heavily bombed.

Areas with lower levels of education can be targeted with school feeding – primarily in districts clustered in group 3, located primarily in the North and Northwest, and groups 4 and 7, located primarily in the center and south of the country along the border with Vietnam. Additionally, clusters 3 and 4 appear to have poor levels of a majority of the

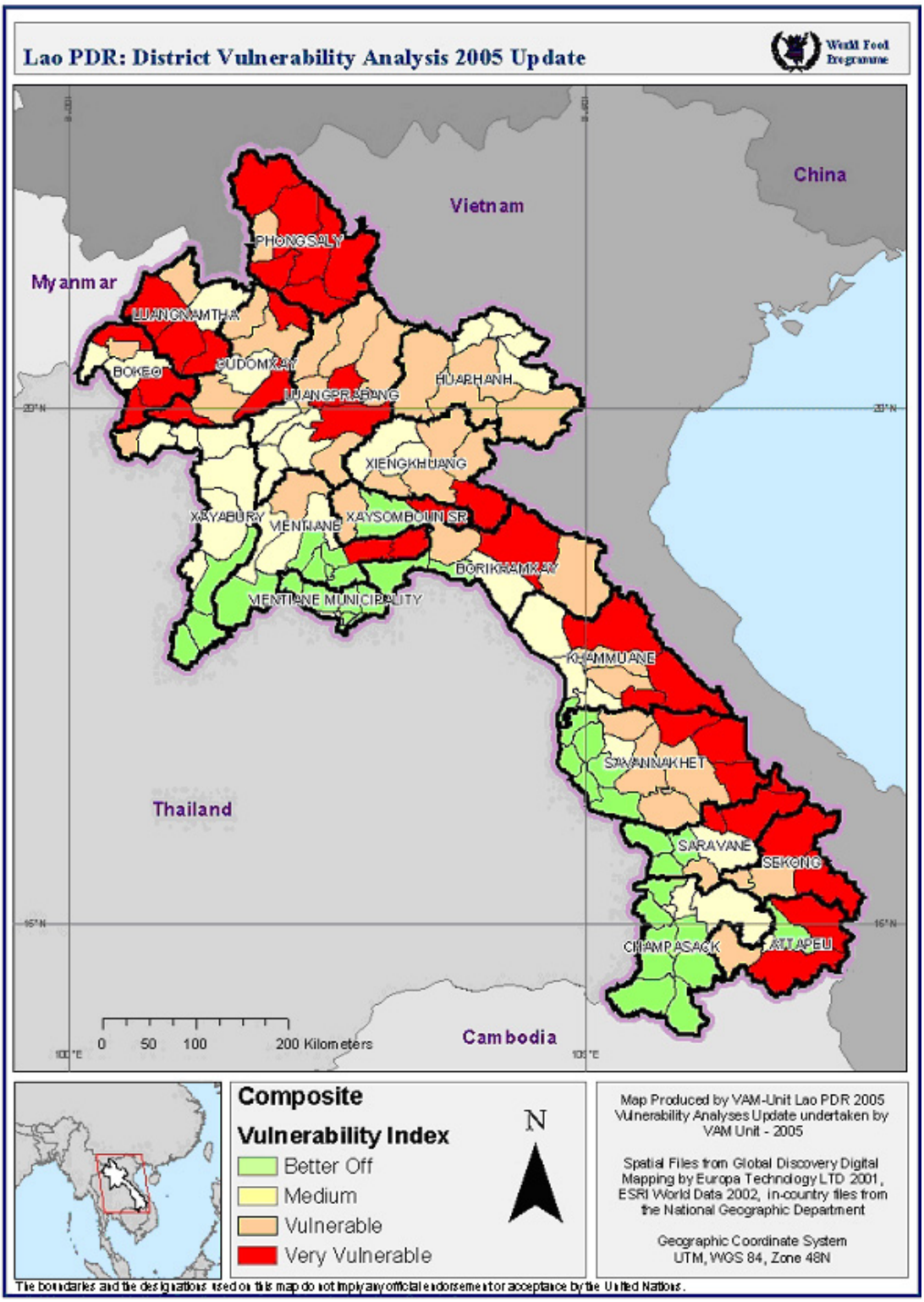
vulnerability indicators, making them good target areas for food for work schemes – such as paddy land expansion or introduction of alternative cropping practices.

Conversely, cluster 2, located in the areas nearer Vientiane, as well as in the south along the border with Thailand, appears to be less vulnerable. It is recommended that these areas be given lower priority in programmes aimed at decreasing vulnerability. However, it needs to be noted that this analysis does not take into account the risk of flooding.
It must be emphasized that this analysis can show the general geographic distribution of vulnerability based on the included indicators, but should be used only in the absence of more specific and reliable data.

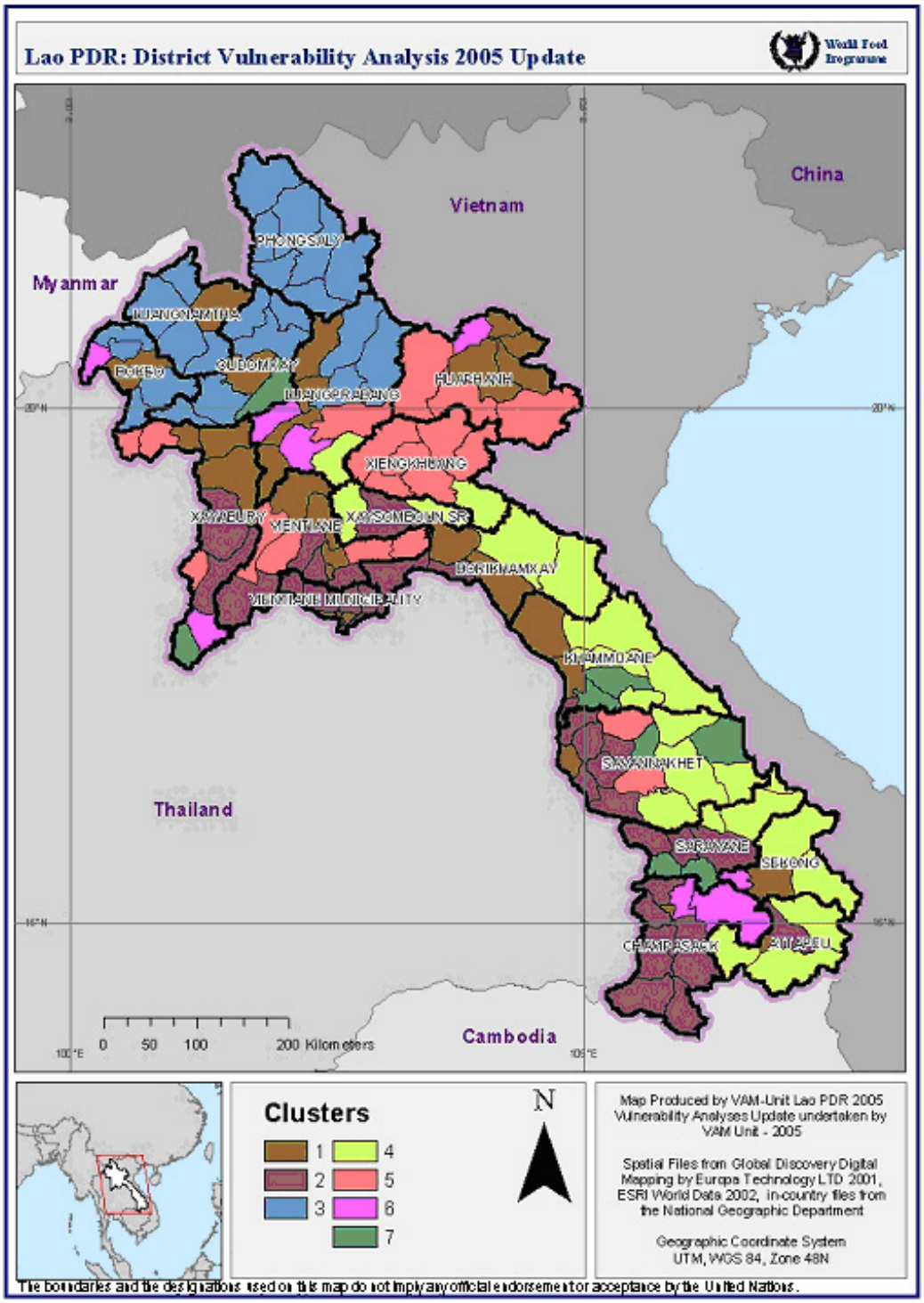
As more recent and reliable data becomes available, this analysis should be updated. However, further information is needed at the household level to be able to identify more clearly the root causes of vulnerability to food insecurity in Laos, the impact at the household level, and the ways people have of coping with this situation. This information can lead to a more informed selection of indicators to include in future district level analysis, as well as indicators that can be regularly monitored through improved early warning or food security monitoring systems.

Annex I- Maps

Map I



Map II



Cluster	1	2	3	4	5	6	7
Rice production per capita	Low	High	Low	Low	Average	Low	High
Cropping diversity	Average	Average	Low	Low	Low	High	Average
Livestock ownership	Average	High	Low	Low	High	Average	Average
Access to forested areas	Low	Average	Average	High	High	Low	Low
Access to roads and rivers	High	High	Low	Low	Low	High	High
Malaria incidence	Low	High	Low	High	Low	Low	High
UXO impact	Low	Low	Low	High	High	Average	High
Incidence of no or low education	Low	Low	High	High	Average	Average	High

Annex 2

Original variable information by district

Province	District	Rice per Capital (kg)	Crop Diversity	Livestock	Forest Area/hh	Road/river access	Malaria Incidence (2002) [3]	Uxo Impact	% household heads with G1 education or less
BOKEO	HUOIXAI	216	31.2	175	1.6	8997	0.1%	0.0	40%
	MEUNG	192	0.9	52	1.2	29032	0.7%	0.0	84%
	NAM NGOU	189	1.8	184	0.0	29772	0.4%*	0.0	53%
	PAKTHA	158	3.7	128	0.1	39402	0.0%	0.0	60%
	PHA OUDOM	145	1.1	147	0.0	31664	0.9%	0.0	62%
	TONPHEUNG	305	93.5	239	1.3	3319	0.5%	0.0	53%
BORIK-HAMXAY	BOLIKHANH	232	13.8	152	8.7	17748	0.2%	1.1	26%
	KHAMKHEUTH	222	8.7	145	12.1	17642	0.2%	1.0	43%
	PAKKADING	300	16.2	187	5.0	8896	0.1%*	0.8	32%
	PAKXANH	521	28.9	152	1.5	7036	0.1%	0.0	20%
	THAPHABATH	464	59.8	259	3.0	7970	0.0%	0.0	22%
	VIENGTHONG	174	7.2	155	17.3	24428	0.0%	1.1	46%
HUAPHANH	ADD	156	91.2	213	0.0	13872	0.0%	0.6	31%
	HUAMEUANG	128	8.4	178	1.0	31093	0.4%	2.6	41%
	SOPBAO	176	33.4	238	0.0	8514	0.0%	0.4	31%
	VIENGTHONG	141	48.3	147	2.3	35172	0.8%	1.7	33%
	VIENGXAY	163	7.2	184	1.0	12289	0.2%	2.6	19%
	XAMNEUA	118	7.7	207	1.7	16322	0.0%	2.6	29%
	XAMTAY	138	9.7	179	0.7	49792	0.4%	0.2	35%
	XIENGKHOR	123	22.7	185	0.0	9804	0.5%	0.2	31%
KHAMMUANE	BUALAPHA	130	0.6	97	4.4	43252	1.4%	5.5	66%
	HINBOON	279	10.9	177	1.7	12179	3.9%	0.6	37%
	MAHAXAY	300	3.2	201	2.1	12892	13.3%	4.1	51%
	NAKAI	191	0.8	143	13.3	32120	10.4%	1.0	64%
	NHOMMALATH	344	1.8	138	2.0	13055	4.4%	3.5	48%
	NONGBOK	478	6	222	0.1	15261	6.0%	0.0	37%
	THAKHEK	210	26.5	214	0.5	7394	1.6%	0.0	29%
	XAYBUATHONG	241	0.9	125	4.3	22794	7.6%	3.9	62%
	XEBANGFAY	339	5.6	215	2.6	11195	15.0%	2.2	48%
LUANG-NAMTHA	LONG	210	4.1	135	2.9	20081	0.2%*	0.3	88%
	NALAE	207	5.1	128	0.1	31022	0.0%	1.4	63%
	NAMTHA	183	7.1	176	1.8	8821	0.3%	0.7	36%
	SING	330	4.5	134	0.7	20072	0.4%	0.2	74%
	VIENGPHOUKHA	216	1.6	69	3.1	23013	0.2%*	0.4	65%
LUANG-PRABANG	CHOMPHET	212	83.8	178	0.0	10290	0.5%	0.7	38%
	LUANG PRABANG	99	67.8	129	0.0	7359	0.2%	1.4	22%
	NAMBAK	193	39.8	172	0.1	15798	1.4%	1.7	42%
	NAN	241	35.9	143	0.4	11970	0.6%	0.0	39%
	NGOI	193	17.1	122	0.7	22559	0.5%	2.0	44%
	PAK OU	233	49.3	136	0.0	8105	1.4%	1.9	47%
	PAK XENG	168	16.8	87	0.0	39125	0.1%	1.3	48%
	PHONXAY	138	4.6	179	0.5	41432	2.3%	2.8	53%
	PHOUKHOUNE	181	35.1	185	1.1	19005	0.9%*	3.1	50%
	VIENGKHAM	155	28.1	169	0.8	32694	0.0%	0.5	43%
	XIENG NGEUN	173	104.5	158	0.0	11095	1.8%	1.4	43%
OUDOMXAY	BENG	252	10.3	169	0.1	11160	0.0%	0.0	44%
	HOON	194	5.2	169	0.3	14138	2.3%	0.0	56%
	LA	199	3.4	97	1.7	29398	2.3%	0.0	60%
	NAMOR	227	5.2	182	1.2	27791	1.6%	0.0	57%
	NGA	182	2.4	137	0.4	28355	13.0%	0.0	63%
	PAKBENG	135	1.8	111	0.0	18811	1.5%	0.0	66%
	XAY	215	9.8	132	0.9	22009	1.3%	0.0	40%

[3] * indicates missing malaria data. These gaps were filled with the average of the other districts in the Province.

Province	District	Rice per Capital (kg)	Crop Diversity	Livestock	Forest Area/hh	Road/river access	Malaria Incidence (2002) [4]	Uxo Impact	% household heads with G1 education or less
PHONGSALY	BOUN NEUA	251	4.9	120	2.0	23579	0.6%	0.0	56%
	BOUN TAY	168	2.8	91	2.3	28401	1.5%	0.0	63%
	KHOUA	91	1.9	58	0.1	14423	1.7%	1.4	46%
	MAY	130	2.8	84	2.1	29661	0.6%	0.7	57%
	NHOT OU	144	2.5	131	5.9	44339	0.1%	0.0	75%
	PHONGSALY	95	1.9	73	8.3	20719	1.2%*	0.0	51%
	SAMPHANH	106	3.7	121	1.1	24968	2.6%	0.6	65%
SARAVANE	KHONGXEDONE	341	39.5	274	0.2	5678	8.7%	3.0	36%
	LAKHONEPHENG	400	1.7	237	2.2	9305	0.9%	0.3	34%
	LAO NGARM	107	72.4	155	0.6	10920	16.6%	3.3	47%
	SAMUOI	178	3.6	73	1.8	12463	2.5%	5.7	90%
	SARAVANE	408	10.9	250	1.8	6304	1.6%	4.6	37%
	TA OI	79	2.5	189	6.4	9714	5.6%	6.1	68%
	TOOMLARN	238	1.8	164	3.8	10626	0.3%	4.6	66%
	VAPY	575	2.6	288	2.2	6593	7.0%	3.4	32%
SAVANNAKHET	ATSAPHANGTHONG	384	2.8	335	0.2	27076	5.7%	2.4	51%
	ATSAPHONE	262	5.6	242	2.5	36555	2.4%	3.4	53%
	CHAMPHONE	452	3.5	305	0.3	24407	3.5%	1.0	42%
	KHANTHABOULY	149	7.9	342	0.4	7228	0.3%	0.0	29%
	NONG	101	1	115	1.9	20572	1.5%	4.1	77%
	OUTHOOMPHONE	227	21	386	0.3	19058	5.4%	0.0	40%
	PHINE	188	3.1	215	1.7	13037	4.8%	5.1	51%
	SEPONE	146	1.7	132	1.5	11192	10.3%	4.5	68%
	SONGKHONE	492	8.8	393	0.5	10013	6.8%	0.0	30%
	THAPANGTHONG	229	1.2	202	2.1	24141	6.2%	1.8	59%
	THAPHALANXAY	329	1.5	196	0.0	26592	9.7%	4.4	43%
	VILABULY	202	1.9	164	3.9	31697	2.0%	5.7	51%
	XAYBULY	363	8.3	288	0.6	8562	2.7%	0.0	38%
	XAYPHOOTHONG	426	35.4	329	0.0	11835	1.1%	0.0	43%
	XONBULY	316	1.2	271	0.4	27697	1.7%	2.6	52%
SEKONG	DAKCHEUNG	130	3.4	84	6.4	25845	2.0%*	3.7	68%
	KALEUM	102	1.1	49	7.5	43504	1.4%	2.9	64%
	LAMARM	194	4.7	103	1.2	12761	2.0%*	3.7	28%
	THATENG	177	85.8	115	2.5	9176	2.5%	3.3	57%
VIENTIANE	FEUANG	278	5.6	297	1.2	37728	0.3%	0.1	28%
	HINHURP	410	10	222	0.0	4241	0.3%*	0.0	24%
	HOM	269	17.7	363	40.7	31021	0.5%	3.5	42%
	KASY	270	25.1	157	2.1	27776	3.3%	1.1	29%
	KEO OUDOM	199	3.5	272	0.6	7438	0.4%	0.0	16%
	LONGXAN	188	8.3	342	7.2	46377	0.1%	1.9	53%
	MET	226	2.6	272	0.0	41090	0.2%	1.6	24%
	PHONHONG	359	3.3	395	0.2	6806	3.4%	0.0	22%
	THOULAKHOM	514	18.7	506	0.4	7069	0.5%	0.0	22%
	VANGVIENG	213	16.2	257	1.3	21367	3.0%	0.6	27%
	VIENGKHAM	233	9.1	296	0.0	13040	1.1%	0.4	24%
	XANAKHAM	311	26	346	0.7	10338	0.8%	0.0	22%
VIENTIANE M.	CHANTHABULY	27	7.8	89	0.0	2604	1.5%*	0.0	11%
	HADXAIFONG	328	79	264	0.0	4583	1.5%	0.0	18%
	MAYPAKNGUM	672	11.2	274	1.1	7891	1.6%	0.4	21%
	NAXAITHONG	445	8.2	364	0.2	6001	3.1%	0.0	18%
	SANGTHONG	371	38.6	310	1.4	12160	1.3%	1.6	25%
	SIKHOTTABONG	75	9	170	0.0	2262	0.6%	0.0	12%
	SISATTANAK	95	10	97	0.0	1386	1.5%*	0.0	12%
	XAYSETTHA	170	5	246	0.0	6194	1.5%*	0.0	12%
	XAYTHANY	429	10.8	409	0.3	7171	0.4%	0.0	18%

[4] * indicates missing malaria data. These gaps were filled with the average of the other districts in the Province.

Province	District	Rice per Capital (kg)	Crop Diversity	Livestock	Forest Area/hh	Road/river access	Malaria Incidence (2002) [5]	Uxo Impact	% household heads with G1 education or less
XAYABURY	BOTENE	318	41	368	0	20835	15.4%	0.0	27%
	HONGSA	207	12.4	236	0	13068	1.5%	0.0	23%
	KENETHAO	222	144.9	338	0.1	14355	0.6%	0.0	27%
	KHOP	182	8.1	330	0.7	58222	1.8%	0.0	31%
	NGEUN	166	11.5	190	0	10942	1.1%	0.0	24%
	PAKLAI	193	31	389	0.7	12179	2.4%	0.0	27%
	PHIANG	291	15	308	5.8	21550	7.4%	0.0	27%
	THONGMIXAY	251	2.8	265	0	47461	2.8%	0.0	27%
	XAYABURY	155	24.6	262	0.8	21263	2.8%	0.0	32%
	XIENGHONE	330	3.6	195	0.2	37795	3.0%	0.0	20%
XIENG-KHUANG	KHAM	228	9	259	0.8	32966	2.9%	3.9	28%
	KHOUNE	200	6.2	232	2	21121	0.4%	4.6	37%
	MORKMAY	174	7.1	207	5.9	22808	0.4%	2.0	63%
	NONGHED	188	26.9	284	0.3	37767	0.3%	2.7	48%
	PEK	135	3.5	374	0.2	28675	0.0%	5.3	20%
	PHAXAY	282	3.4	223	1	34957	0.9%	5.9	31%
	PHOOKOOD	185	3.5	489	2.1	27644	0.5%	6.7	20%

[5] * indicates missing malaria data. These gaps were filled with the average of the other districts in the Province.

Annex III

Averages of the 8 indicators used in the cluster analysis by cluster

Cluster	1	2	3	4	5	6	7	Total
Rice production per capita (Kg)	183.4	400.6	179.1	185	213.9	178.2	257.8	**239.9**
Crop diversity	19	18.8	5.7	4.9	9.4	124.2	20.9	**19.4**
Livestock ownership	191.2	328.5	118.4	146.2	269.5	197.5	209.7	**215.2**
Access to forested areas/household	0.97	1.4	1.54	6.97	3.36	1.11	0.93	**2.41**
Access to main roads/rivers (meters)	10,637	10,426	26,812	21,620	37,082	10,674	15,957	**18,751**
Malaria incidence (2002)	1.20%	3.00%	0.90%	3.10%	1.10%	1.60%	12.70%	**2.50%**
UXO impact	0.77	0.78	0.38	3.54	2.6	1.68	2.7	**1.54**
% household heads with G1 education or less	28%	29%	60%	59%	35%	39%	48%	**41%**