BRIEFING NOTE

January 2018

Pesticide Use in Lao PDR: Health and Environmental Impacts

HIGHLIGHTS

- Agricultural commercialization in Laos is driving a dramatic increase in pesticide use.
- Existing data suggest that overuse of pesticide is common and contamination wide-spread.
- The problem is not limited to rural and remote areas but also present in urban centers.
- Consumers appear to have higher levels of exposure to pesticides than farmers.
- Regular testing using strict protocols is necessary to provide accurate information.
- The dangers of pesticides among farmers are common knowledge. Alternatives to pesticides and knowledge on how to reduce pesticide use are not.
- The likely significant socio-economic costs in Laos need to be determined through further analysis.
- Laos has a wealth of experience in sustainable agriculture. These practices can be scaled up to provide farmers a concrete alternative to growing reliance on chemicals.
- Closer coordination between government and development partners is needed to better identify the problem and to work with farmers to create solutions.

ACKNOWLEDGEMENTS

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AUTHORS

Sopavanh Rassapong, Knowledge Management for Sustainability Consultant, Lao Upland Rural Advisory Service

Chanthaly Syfongxay, Head of Crop Division, Xiengkoung Provincial Agriculture and Forestry Office

Ianlang Phanthanivong, Crop Specialist Xiengkoung Provincial Agriculture and Forestry Office

Bounlue Syhalad, Plant Protection Specialist Xiengkoung Provincial Agriculture and Forestry Office

Soubin Phimmahthut, Technical Official Ministry of Public Health

Thongsern Manyvong, Technical Official Ministry of Public Health

Bandith Keothongkham, Director Rural Development Sole

Dr. Surat Hongsibsong, Environmental Scientist Environment and Health Research Unit, Center for Apply of Health Science, Research Institute for Health Science, Chiang Mai University

Annie Shattuck, Researcher, Department of Geography, University of California Berkeley

Andrew Bartlett, Team Leader Lao Upland Rural Advisory Service

BACKGROUND

According to the 8th Five Year National Socio-Economic Development Plan (8th NSEDP) (Ministry of Planning and Investment, 2016), the Lao government has set a goal to eradicate poverty in Laos and remove the country from Least Developed Country status by 2020. The agricultural sector is an essential sector for national development. Also, the 8th NSEDP promotes development of the 'green economy' to conserve natural resources besides maintaining economic development. Recently, the Government of Laos has tightened regulations on pesticides nationwide through a new decree (No 258/GOL issued in August 2017). Supporting government efforts to promote a greener economy and enforce the new decree requires a detailed understanding of the trends and impacts of pesticide use.

Growing public concern

There has been widespread public concern within Lao about the impacts of pesticides on health and the environment. In a previous briefing note Rassapong, (2016) summarized earlier studies conducted by government agencies, international organizations, and civil society, including studies supported by the Lao Upland Rural Advisory Service (LURAS), that indicated an increase in pesticide use is likely to have significant environmental and health impacts.

In the last eighteen months, more data has been collected by the Department of Agriculture (DAO), the Ministry of Health, the International Water Management Institute (IWMI), the Ministry of Natural Resource and Environment (MONRE), Souphanouvong University, LURAS and the PAFOs in Xieng Khouang and Oudomsay. This briefing note brings all the available data together as an updated version of briefing note on pesticides.

"Supporting government efforts to promote a greener economy and enforce the new decree on pesticides requires a detailed understanding of the trends and impacts of pesticide use."

INCREASING PESTICIDE USE

Overall, pesticide use is increasing dramatically in Laos due to labor constraints and shifting orientation from subsistence farming to commercialization. Commercial crop expansion has increased use of pesticides. Over the past seven years (2006-2012), legal imports of insecticide increased 0.08 to 19.53 metric tons, while herbicide import also increased from 0.04 and 23.48 metric tons.

A recent report from the DOA (2017) shows in 2016, 136.247 metric tons of pesticide was legally imported by 33 companies. Of these, there are 60 formulations including 23 insecticides, 12 herbicides, 19 fungicides, and 1 rodenticide. 193 pesticide shops are registered to sell pesticides in Lao PDR (DOA, 2017).

2016 Pesticide surveys in Kham and Nonghad districts, Xiengkoung province in particular show 101.047 metric tons of pesticides imported from Vientiane, Vietnam and neighboring districts according to Xiengkoung PAFO (2016).

Again however, these figures only reflect the legal pesticide trade. Data on the illegal and informal pesticide trade are not available, but the data that do exist suggest that legal imports are only a fraction of the total pesticide imported to Lao PDR (SAEDA 2010).

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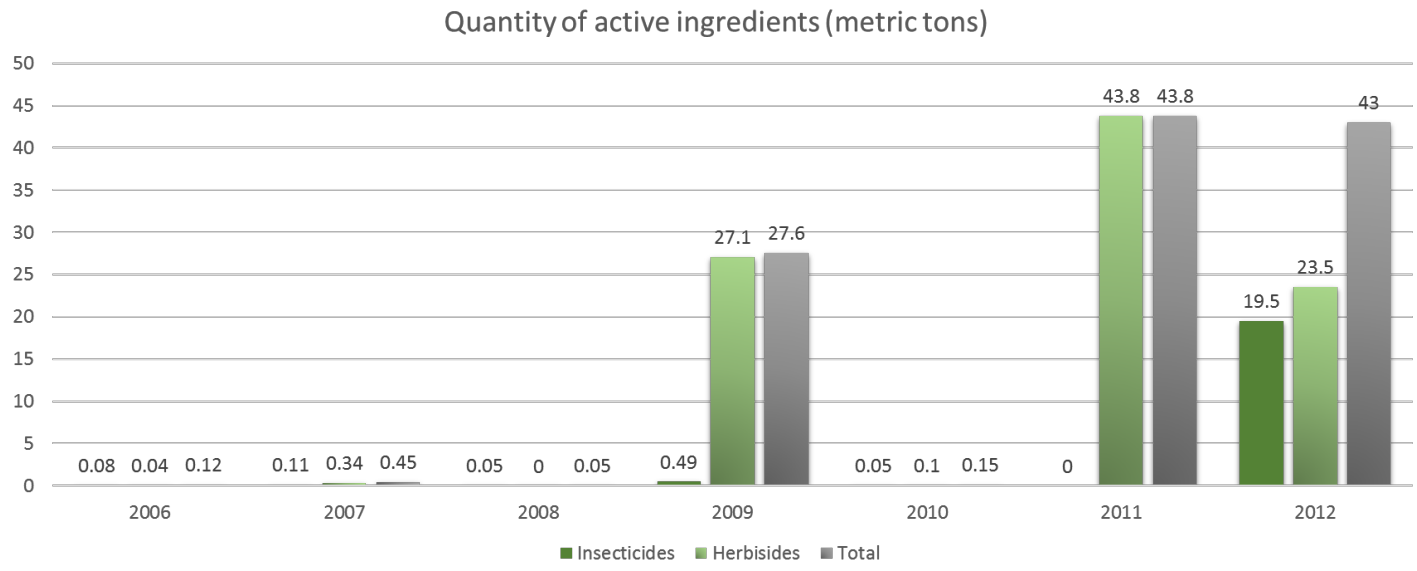
Chart 1: Pesticide Import in Laos during 2006-2012



(Source: DOA, 2014)

In Kham and Nonghad districts, Xiengkoung province, maize is the number one commodity, and predominantly requires herbicides. Xiengkoung PAFO (2016a&b) demonstrated that in 2016, herbicide was applied on 64% of surveyed maize farms in Kham and on 85% of surveyed maize farms in Nonghad. TABI[1] (2014;2017) reports that in 50 villages of Huaphan province and 18 villages of Luang Prabang province pesticide was applied on 579.5 ha and 1940 ha, respectively.

Pesticide use spreading to subsistence farms

Pesticide use may have begun in the main commercial crops, but according to data on five villages in Xieng Khouang (Rassapong 2017), they are increasingly being used for subsistence and local market crops including paddy rice, upland rice farms and vegetable gardens.

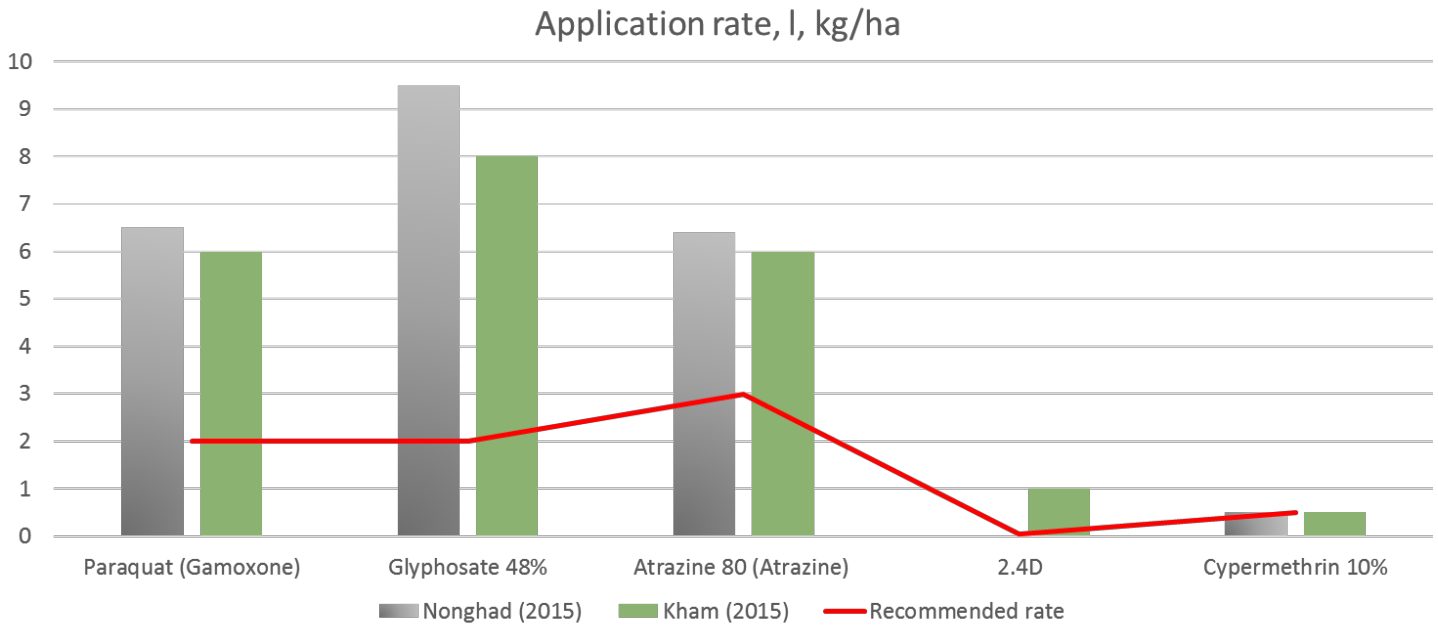
Common insecticides in vegetable producing communities include Cypermethrin and Carbaryl (TABI, 2017& 2017; Xiengkoung PAFO 2016a&b; Rassapong, 2017; Rural Development Sole, 2017). According to Rural Development Sole (2017), the average pesticide solution that farmers use ranges between 946-1783L/ha/year, and average exposure is between 93-128 days/year.

"Application rates for herbicide are consistently 2-4 times higher than Recommended."

Common herbicides in Xieng Khouang include Glyphosate, Atrazine, Paraquat, 2.4D, and Metsulfuron methyl10%. Despite the ban, Paraquat is one of the most commonly used herbicides (TABI,2014 & 2017; Xiengkoung PAFO 2016a&b; Rassapong, 2017; Rural Development Sole,2017). Application rates for herbicide are consistently 2-4 times higher than recommended, but the recommended rates may not be applicable for the often steep landscape with perennial weed species in Laos.

Shattuck (2017) explained that herbicides allow farmers to convert soil into cash through expanding maize farms. Even though awareness of the dangers of pesticide is nearly universal in the maize communities surveyed, the current practices of pesticide use such as mixing chemicals in open tarps in stream beds are practical solutions for people with few resources and limited labor.

Chart 2: Pesticide application rate use in Kham and Nonghad



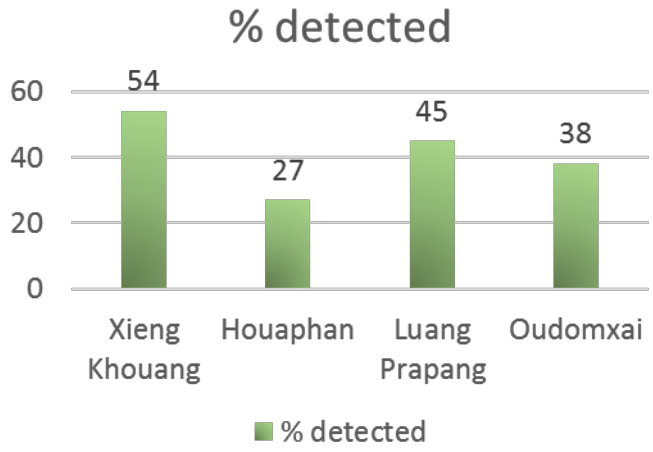
[1]TABI - The Agrobiodiversity Initiative, a project funded by the Swiss Agency for Development Cooperation (SDC)

FOOD SAFETY

Contamination of fresh fruit and vegetables is likely widespread. Collectively over half (52.4%) of the samples screened in the last two years tested positive for residues of organophosphate and carbamate, a common class of insecticide that is linked to nervous system and neuro-developmental disorders in children.

The Provincial Agriculture and Forestry Offices in Xieng Khouang and Oudomsay, as well as Dr. Vongpasith Chanthakhoun, Dean of the Faculty of Agriculture at Souphanouvong University have been working on screening common fruits and vegetables for pesticide residue with support from LURAS using the Gt test kit, a common low cost initial screening test developed by the Thai Ministry of Health.[2]

Chart 3: Pesticide residue on produce



(Data source: Xiengkoung PAFO, 2017; LURAS Oudomxai, 2017; Chanthakoun,V., Manysoat,S., Bandavong,V., 2016)

"Collectively, over half (52.4%) of the samples screened tested positive for residues of organophosphate and carbamate that are linked to nervous system and neurodevelopmental disorders in children."

In Xieng Khouang, PAFO officials screened 616 fruits and vegetables from local producers' groups and markets in seven districts. This isthe largest survey to date in Laos of vegetable residues. Of those, 54% tested positive for residues, and 16% tested positive at unsafe levels. Residues were detected on 45% of produce tested directly on local farms, and on 50% of domestic produce sold in local markets.

Imported produce also contaminated

Imported produce appeared slightly worse: 74% of imported produce sold on local markets tested positive for residue, 32% at unsafe levels, the majority of imported products tested were fruits. There is no comparison to a commercial fruit industry in Laos, and there is not enough data to say definitively by product or origin what the differences in contamination rates may be. There were no products tested that were always completely clean. Additional testing is needed to identify what, if any, specific crops are of concern.

[2] The Gt test kit gives a measure of enzyme activity for cholinesterase, an enzyme inhibited by carbamate and organophosphate insecticides. The test gives a qualitative result (detected/not detected) as well as a category for the level of enzyme inhibition (safe or unsafe). The margin of error for Gt test kits is high; generally Gt tests are used as tools to screen samples before laboratory testing with liquid or gas chromatography, which can cost between 80-100 USD per sample. Lab capacity for these procedures does not yet exist in Lao PDR. The Gt test cannot pick up other common types of insecticide, like Pyrethroids and Neonicotinoids, and it cannot detect fungicides, all of which are commonly used in Lao

In Oudomxai, of the 48 samples taken from local fresh markets of both imported and local produce, 18 tested positive for residues. In two districts of Luang Prabang Province, 45% of samples detected residues; in Houaphan, 27% tested positive.

The Xieng Khouang PAFO also tested vegetables directly from home and commercial gardens in villages actively trying to reduce pesticide use in Kham District. Of the 45 samples tested there, 22 tested positive for residues. Remote villages growing vegetables in home gardens tested positive for pesticide residues at similar rates to farmers producing vegetables commercially.

Consumers have higher residue levels than farm workers

Given the limitations of the testing, these results are preliminary, but they indicate the likelihood that contamination of fresh produce is widespread. These results are supported by tests of blood and urine samples among farmers, consumers and school children in Xieng Khouang and Vientiane. Consumers, especially government officials, consistently had higher levels of pesticide in their blood and urine, indicating that exposure is likely coming from food rather than directly from farm work.

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Table 1: Pesticide Residue Test in Xieng Khouang province

Pesticide Residue Tests Xieng Khouang by Source						
District	Provincial markets - Domestic Produce		Provincial Markets - Imported Produce		Direct from farmers	
	Total Samples	% of unsafe	Total Samples	% of unsafe	Total Samples	% of unsafe
Nonghet	18	5.6	8	12.5	21	4.8
Kham	56	12.5	24	16.7	19	10.5
Mork	51	13.7	18	27.8	31	0.0
Khoun	33	18.2	15	33.3	37	0.0
Phaxay	46	8.7	15	13.3	13	15.4
Phoukout	55	7.3	22	31.8	22	22.7
Paek	60	23.3	29	62.1	17	29.4
Total (%)	319	13.5	131	32.1	160	9.4

(Adapted from: Xiengkoung PAFO, 2017)

PUBLIC HEALTH

Children, consumers and farmers all have evidence of pesticide contamination in their bodies. Almost everyone is exposed. Recent blood tests of nearly 1000 school children, farmers and consumers showed that few – only 4% - showed no sign of contamination whatsoever.

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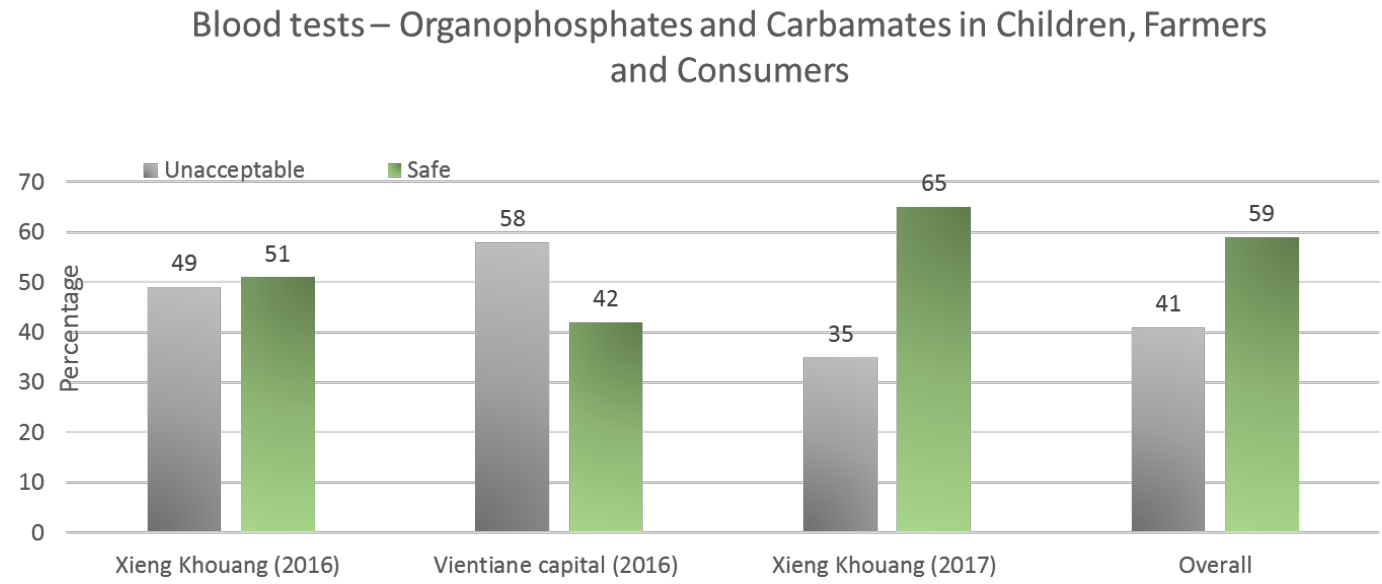
Rapid blood tests can detect the impact of common insecticides in the body. [3] rapid test rates each subject as normal, meaning no contamination, safe, risky, and unsafe. In March 2017 the Provincial Health Departments, Rural Development Sole, Xieng Khouang PAFO and LURAS tested 999 farmers, consumers and school children in five villages in Kham District, Xieng Khouang province. Each of these villages produces maize primarily, as well as rice, cattle and vegetables. Three produce vegetables commercially for local markets. These tests followed a smaller sample of children, farmers and consumers conducted in 2016 in vegetable producing villages in Xieng Khouang and Vientiane.

Overall, 35% of those tested had unacceptable – risky or unsafe – levels of pesticide in the blood. Of the 422 primary and secondary school students tested, 33% were exposed at unacceptable levels. Of 494 farmers, 34% were risky or unsafe. (Adapted from Rural Development Sole, 2017)

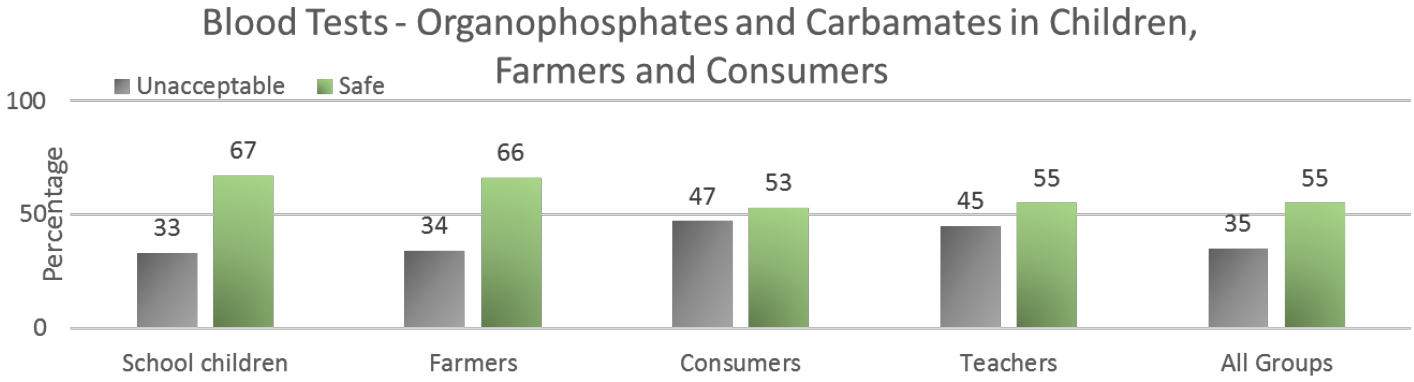
Chart 4: Blood Tests - Organophosphates and Carbamates in 2016 and 2017



(Adapted from Rural Development Sole 2016 & 2017)

[3] The rapid blood test measures the level of cholinesterase, an enzyme essential to the healthy function of the nervous system, which is inhibited by exposure to organophosphate and Carbamate insecticides. Cholinesterase inhibition can also be caused or complicated by anemia, malnutrition, liver disease and hepatitis, all of which are common in upland farming communities in Lao. The rapid tests cannot measure exposure to common herbicides like Glyphosate, Paraquat, 24D and Atrazine, nor does it measure other common types of fungicide or insecticides.

Chart 5: Blood Tests - Organophosphates and Carbamates in Xieng Khouang Province in 2017



(Adapted from Rural Development Sole, 2017)

Consumers, many of them government officials, had the highest rates of contamination – 47% of consumers were in the risky and unsafe categories. This group does not work directly in agriculture. They were exposed either through residues on food, or from living near fields. Similarly 45% of teachers were risky or unsafe. This result was consistent with tests conducted in 2016 as well indicating consumers, often with higher incomes, may be more consistently exposed than farming communities.

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Urine samples from 20 farmers, students and government officials were taken to corroborate the blood tests and assess exposure to other classes of agrichemicals. When pesticides are absorbed into the body they break down into metabolites which are then excreted through urine.

In 2016, the Provincial Health Departments and Rural Development Sole tested 449 students and teachers in Vientiane, 58% had unacceptable levels of exposure.

Urinary metabolites of Organophosphates, Pyrethroids and Glyphosate were measured by Dr. Surat Hongsibsong at Chiang Mai University Research Institute for Health Science. Organophosphate metabolites were detected in 85% of the participants. Glyphosate was detected in 25% of the urine samples – notably those samples came from two farmers and three young students. The four high ranking local government officials who participated had the highest levels of metabolites in urine.

The problem is nationwide

In 2016, Provincial Health Departments and Rural Development Sole tested 767 school children and teachers in Xieng Khouang. 49% had unacceptable levels of exposure. In Vientiane, of 449 students and teachers tested, 58% had unacceptable levels of exposure.

Exposure widespread despite knowledge of protective measures

While there is no rapid blood test for herbicide exposure, signs of exposure to herbicides in maize producing communities are nearly universal. In a survey of 103 farmers and pesticide applicators in Xieng Khouang, over 90% reported at least one symptom of acute exposure after applying pesticide including headache, dizziness, rash, nausea, vomiting and difficulty breathing (Shattuck 2017). Among this group, knowledge of protective equipment use was nearly universal.

Exposure at this level can cause chronic health issues, especially for women and children, even when no immediate symptoms exist. No national system of health surveillance exists to track accidents with pesticides, acute poisoning cases or long term health issues related to pesticide exposure.

While the rapid tests are not perfect, the widespread consistent results and urine samples in the lab indicate that exposure is widespread and affects even people who do not use pesticide in their farms.

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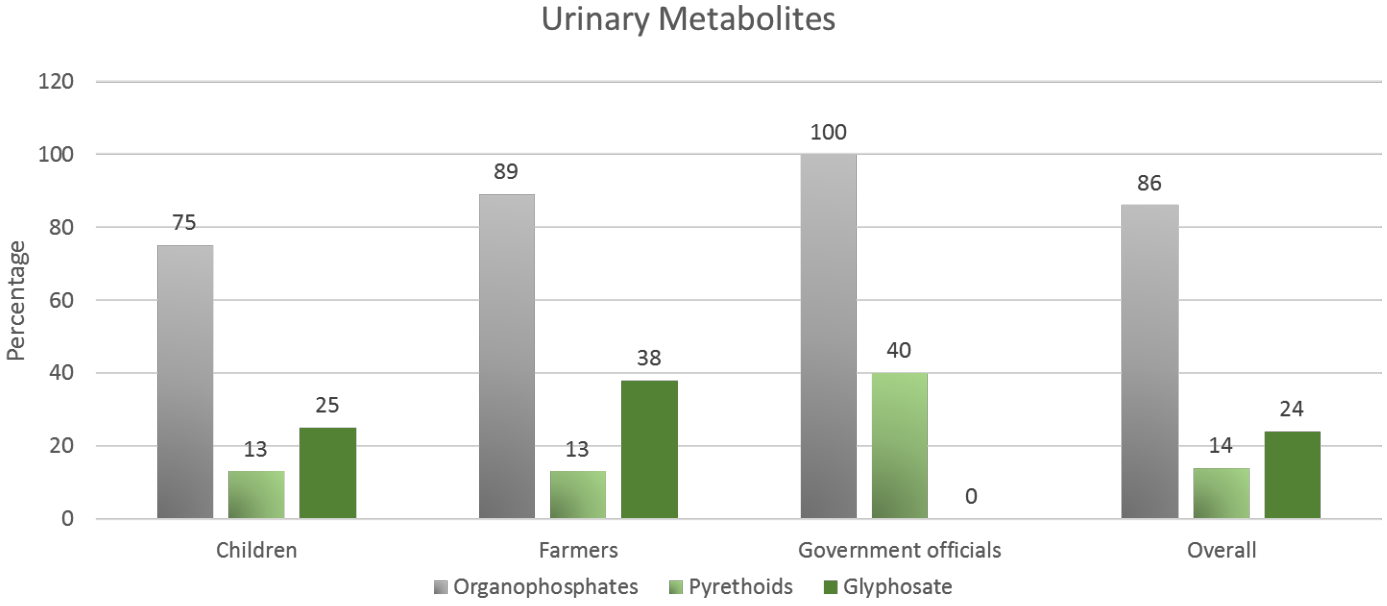
Chart 6: Urinary Metabolites



(Data source: Hongsibsong,2017)

ENVIRONMENTAL RISKS FROM PESTICIDES

Pesticides are staying in the environment. The presence of pesticide in water and stream sediment indicates that pesticides are not staying on the farm, which may have biological effects we did not test for. In June 2017, the Environmental team of LURAS assessed pesticide contamination in the Environment. 19 water and sediment samples were collected from Kham district, Xiengkoung province, where maize is largely grown for commerce and herbicides are intensively used. Test results indicate low level contamination compared to international guidelines (see table 2).

"The presence of pesticides in water and stream sediment indicates that pesticides are not staying on the farm."

Table 2: Pesticide contamination in water and sediment

Environmental Compartments	Atrazine		Paraquat		Cypermethrin		Chlorpyrifos	
	Detected concentration range	International guidelines	Detected concentration range	International guidelines	Detected concentration range	International guidelines	Detected concentration range	International guidelines
Water (mg/L)	0.0004-0.0018	0.1* 0.013**	Not detected	0.020**##	Not detected	0.020**##	Not detected	0.030**##
Sediment (mg/kg)	0.015-0.03	0.0088*** 0.0088***#	0.03-0.93	1.100*** 1.100***#	0.001-0.003	Not available	0.005-0.013	49.000*** 3.2***#
% of detected water samples	40%		0%		0%		0%	
% of detected sediment samples	11%		67%		44%		22%	

(Data source: Research Institute for health science, Chai Mai University,2017).

*WHO guideline for drinking water ** Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
*** Canadian natural soil guidelines ***# Canadian agricultural soil guidelines **## Australian drinking water guideline

Note: There is not a single international standard for these detected pesticides, but these guidelines are used by Chiangmai University

Notably, Atrazine contamination was found in a water supply source of the village. Atrazine is one of common pesticides in Phonsai village. Additionally, Cypermethrin, Chlorpyrifos, Atrazine and Paraquat were detected in sediment samples collected from all sampling locations within Phonexai and Na oung villages, Kham district. Atrazine contamination found in sediment at Phonexai village is slightly higher than Canadian soil guidelines. This possibly affects microorganisms in natural and agricultural soils. Na oung is one of vegetable production villages, where insecticides are used.

Combat pesticide use before situation worsens

Even though levels of pesticide contamination are relatively low at the present in this area, it can be high in the future if there are not alternatives for current agricultural practice.

In another part of Laos, pesticide contamination poses more concerned in terms of environmental risks, compared to the case in Xiengkoung province. Wentworth and colleagues (2016) assessed environmental risks from commercial banana farming in Sibounhueang village, Houn district, Oudomxai province. Their assessment shows that 96% of samples were contaminated by pesticides. 20 of 40 compounds were detected. Of these, 11% of pesticide detection including heptachlor, Imidacloprid, and Paraquat exceed WHO guidelines. Notably, average number of pesticide detection in surface water from banana plantation is 2.4 times higher than detection from other commercial crops.

“96% of samples from commercial banana farming were contaminated by pesticides.”

“Even though levels of pesticide contamination are relatively low at the present, they can be high in the future if there are not alternatives for current agricultural practice.”

In addition, a report of Ministry of Natural Resource and Environment (MONRE) (2016) illustrates that pesticides including Carbendazim, Glyphosate, Paraquat, Dicofol Cypermthrin were detected in soil samples from 6 locations of Tonpherng and Phaoudom districts. Paraquat and Glyphosate detection are high compared to an agricultural soil guideline (Alberta Government, 2016). A high level of Glyphosate detection is 0.1mg/kg, while high levels of Paraquat detection range between 0.10-29.41mg/kg (MONRE, 2016). These levels of pesticide contamination in the environment are possibly harmful to aquatic and terrestrial ecosystems.

CONCLUSIONS AND RECOMMENDATIONS

Growing commercialization of agriculture in Lao PDR is driving a dramatic increase in pesticide use. Official statistics on pesticide use in Laos show an increase of 236% over ten years. This only includes the pesticides coming in through legal channels.

Gathering data on the impact of this increase is difficult, expensive and requires collaboration between many government agencies. The data that exist however suggest that contamination is widespread and overuse of pesticide is common. There is a need to develop rigorous protocols and capacity to monitor and remediate pesticide contamination at the provincial and national levels. Regular testing using reliable procedures which provide accurate information producers, consumers, and government regulators is a prerequisite for addressing ongoing concern and food safety in Laos.

Rural Development Sole and the Provincial Health Departments have tested the blood of over 2000 students, teachers, farmers and consumers in the past two years. 41% show unacceptable levels of contamination. This is especially worrying for two reasons: First, the tests show young school children are exposed at unacceptable levels. Contamination at this age may impact the development of children's brains. Second, consumers seem to have higher levels of exposure than farmers, meaning that pesticide residues are a serious issue. Initial residue screening tests also indicate contamination is widespread, though more rigorous testing needs to be done. This issue is not limited to remote areas.

The testing conducted in Vientiane suggests that both contamination and extensive pesticide use is an issue in the capital as well.

Socio-economic costs of this issue undoubtedly exist but have yet to be determined, from chronic impact on health and productivity, loss of biodiversity and associated food sources, potential trade restrictions, unnecessary costs to farmers, and costs to government regulatory agencies. In other words, food safety should be seen as a cross-cutting development issue.

Consumer awareness-raising is urgently needed to reduce exposure of the most vulnerable groups, especially pregnant women and children. This however is not enough. The dangers of pesticide among farmers is common knowledge. Alternatives to pesticides and knowledge on how to reduce pesticide use is not. We have a systemic problem which therefore requires a systemic response. The problem cannot be solved by safe use trainings, nor can government be expected to deal with the issue from a solely regulatory standpoint. We need more integrated efforts at the local level, bringing together agriculture, health, education and extension. Coordinated government and development efforts can better identify the problem, and work with farmers to create a solution.

Lao PDR has a wealth of successful experience in sustainable agriculture, including agroecology, integrated pest management, system of rice intensification, alternative crops, wild food production and organics. These solutions need to be scaled up to give farmers a concrete alternative to expanding agrichemical dependence.

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DTEAP
Department of Technical Extension and Agro-Processing

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