The International POPs Elimination Project

Fostering Active and Effective Civil Society Participation in Preparations for Implementation of the Stockholm Convention

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Identification of a POPs Hotspot – Examination of DDT and Lindane (BHC) Residues in Potato and Farm Soil

Pesticide Watch Group
Nepal Forum of Environmental Journalists

Kathmandu, Nepal
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About the International POPs Elimination Project

On May 1, 2004, the International POPs Elimination Network (IPEN http://www.ipen.org) began a global NGO project called the International POPs Elimination Project (IPEP) in partnership with the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Program (UNEP). The Global Environment Facility (GEF) provided core funding for the project.

IPEP has three principal objectives:

- Encourage and enable NGOs in 40 developing and transitional countries to engage in activities that provide concrete and immediate contributions to country efforts in preparing for the implementation of the Stockholm Convention;

- Enhance the skills and knowledge of NGOs to help build their capacity as effective stakeholders in the Convention implementation process;

- Help establish regional and national NGO coordination and capacity in all regions of the world in support of longer term efforts to achieve chemical safety.

IPEP will support preparation of reports on country situation, hotspots, policy briefs, and regional activities. Three principal types of activities will be supported by IPEP: participation in the National Implementation Plan, training and awareness workshops, and public information and awareness campaigns.

For more information, please see http://www.ipen.org

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Executive Summary

Study Goal

The goal of the study was to identify the POPs hotspot area among the vegetable growing areas in Nepal with an objective to involve common grassroots people and NGOs in the global POPs eliminations campaign through awareness programs about POPs that are being used in their environment.

Project Activity

The project is divided into Phase I and Phase II activities. The Phase I activities consist of inventory preparation of vegetable item "potato" sourced into vegetable markets of Kathmandu focusing mainly on demand and supply situation, identifying product sources (commercial farms etc.) followed by determination of residual levels of DDT and Lindane (BHC) in potato from different source areas and information sharing on residual levels of DDT and Lindane (BHC) in potato with the consumers and dealers in the market chain with a purpose to make them aware of the harmful consequences of the DDT, Lindane (Lindane BHC) residues as a part of the campaign for the elimination of POPs from the environment.

The Phase II activity consists mainly of an investigation of identified DDT and Lindane (BHC) contaminated potato farm areas followed by collection of soil samples from the farm, analysis of soil samples for residual DDT and Lindane (BHC) and information sharing with the farmers, consumers and government agencies on the implication of the observed residual levels on the environment and consumer's health.

Project Findings

The project findings of the Phase I and Phase II activities were presented as separate reports to the hub in January 2005 and April 2005 and are also presented as Attachment 1 and 2 of this report. The key findings of the project are briefly summarized as under:

Phase I Findings:

- *There were more than 20 different source localities, which supply potato to Kathmandu vegetable markets including localities from India, Bhutan and Tibet.*
- *Seventeen samples of potato sourced from four districts of Nepal and one from India were collected and analysed for DDT and Lindane (BHC) residue*
- *About 18 % of the samples examined showed residue contents of DDT and Lindane (BHC) above detection limits.*

The residual levels of DDT and Lindane (BHC) were found to be below the Codex value for cereals, eggs, and milk, and not high enough to cause immediate health concern to potato consumers or to the environment. However, note that the above POPs have bio accumulative character and will build-up within people when consumed regularly even in very low concentrations thus contributing to body burdens and potentially cause health concerns in the long-term.

Phase II Findings

- *Sixteen soil samples showing residual DDT and Lindane (BHC) above detection limit in potato representing four districts of Kathmandu were collected and analysed for residual DDT and Lindane (BHC)*

- *DDT and Lindane (BHC) were used for the potato crops for pest control some 10 to 15 years before in the survey localities. In the recent years, with the enactment of Pesticide Act and Regulation, which bans DDT and Lindane (BHC) for production and use, they have been replaced by other pesticides for crop protection.*

- *Altogether 37% of the collected soil samples showed residues of Lindane (BHC) at levels of detection. While none of the soil samples indicated DDT residue above the instrumental detection limit. Should state detection limit here*

- *Residual concentrations observed for the analysed soil samples are below the USEPA minimal risk levels (MRL) values and are considered safe from immediate environmental and ecological consideration. However, note that the bio-accumulative character of these chemicals means that members of the upper food chain system could accumulate high concentrations of these substances despite low initial environmental concentrations. Hence, the legal instruments in prohibiting the use of POPs are very important*

Awareness Activities

Focusing the case of DDT and Lindane (BHC) use and its residue levels in crops and soil, POPs elimination awareness programs including information sharing and interactions with the stakeholders were organized at various levels in different times during and after the completion of the project. The key target stakeholders for preparation of awareness materials on POPs and its effects to health and environment were the environmental journalists working in the print, radio, and TV media. Besides, potato dealers, stockist, retailers, and consumers in the market chain and farmers in the production base were also targeted for awareness raising at the grass root levels. The following activities highlight the efforts of the Pesticide Watch Group on the awareness building for POPs elimination.

- Interaction meeting with the environmental journalists and release of the residue level database of the Phase I activity outcome – 25 January 2005 at NEFEJ Hall, 15 environmental journalists covering print, radio and TV media participated;
- Radio program on the pesticide issue, focusing on POPs at Radio Sagarmatha, First community radio in South-Asia – 8 February 2005. Program addressed the consumer on

the maters related to POPs. Also released the database on DDT, Lindane (BHC) residue level situation in potato available at Kathmandu market;

- Interaction with the dealers, stockists, and retailers of the Kathmandu market on the issue of POPs and its residue levels in potato supplied in the Kathmandu market and their role in the POPs elimination campaign;
- Interaction meeting with the farmer communities and discussion on the observed residue levels of DDT and Lindane (BHC) in potatoes of the farm - March 2005 in the four districts supplying potato to Kathmandu markets and collection of composite soil samples for residue analysis for DDT and Lindane (BHC);
- Interaction meeting with the environmental journalists and release of the residue level database of the Phase II activity outcome – 15 April 2005 at NEFEJ Hall, 13 environmental journalists covering print, radio and TV media participated; and
- Release of the DDT land Lindane (BHC) residue level database of Phase I and Phase II activities in the interaction program "Battle with persistent Organic Pollutants (POPs): Problem of POPs in Nepal, organized on the occasion of Global POPs Week (17 – 23 April 2005) on 22 April 2005 by Nepal Forum of Environmental Journalists (NEFEJ), Pesticide Watch Group. The interaction meeting included over 40 participants representing concerned government agencies, members of POPs Enabling Activities Project, civil society, environmental journalists and other institutions.

Conclusion and Recommendations

The potato source area of Kathmandu vegetable market under investigation has been under application of DDT and Lindane (BHC) in the past. In the last 10 to 15 years, the DDT and Lindane (BHC) pesticides are not reported to have been used. The DDT and Lindane (BHC) residual analysis carried out during this study in the vegetable item (potato) and soil do not show residual levels above US EPA MRL values of environmental and ecological concern. As there are no quantitative databases on the application of DDT and Lindane (BHC) in the past and its actual area coverage, it is not possible to ascertain the entire agricultural farms as environmentally and ecologically safe from the above POPs. However, the obtained DDT, Lindane (BHC) residual analysis results of potato and farm soil reveals that the coverage of the contaminated POPs hotspot, if any, is limited to small localized pockets only. Such potential localized POPs hotspot pocket area could be confined to areas where eroded sediments from the DDT, Lindane (BHC) applied agricultural fields are deposited such as ponds, lakes, and the aggradational (depositional areas) river/stream beds. Future studies for the identification of hotspots should concentrate in those areas.

It is to be noted that the POPs have been legally banned for agricultural use since 1993 in Nepal. Field interaction with the local farmers also reveals that the DDT and Lindane (BHC) in the agricultural farms were replaced by the other pesticides during the same period (after 1993). This shows that the enforcement of legal tools for the control of POPs, in the context of Nepal is very effective. The residue analysis of 1980, 1994 and the present also conforms the gradual decline of DDT, Lindane (BHC) residues in the vegetable items over the years.

It is true that POPs pesticide use in Nepal has declined over the years. The major reason is the legal restriction. The farmers are not using it, because it is not readily available on the market. The question whether they will use it or not if it is made available by any source and means is doubtful. The knowledge of the common Nepali farmers on the POPs pesticides is very limited. Most of them do not even know what POPs are, or what harms they can pose to public health and environment. Future programs on POPs elimination, hence, should target the awareness level of the common Nepali farmers together with an exchange of information on why certain pesticides including POPs have been legally restricted for use in Nepal.

Attachment 1

First Phase Report

IDENTIFICATION OF POPs HOT SPOT – Examination of DDT and Lindane (BHC) Residues in Potato and Farm Soil

Table of Contents

1.0 Introduction

1.1 General

Persistent Organic Pollutants (POPs) as the name suggests are a class of chemicals that are found almost everywhere around us albeit in a very small concentrations because of their inherent properties, but constitutes a potential risk to human health and the environment. However, it is to be borne in mind that most chemicals identified, as POPs so far, are synthetic and originally made and used for the benefit of agriculture, industry and utility products.

The identified POPs targeted for release reduction and eventual elimination from the environment are: aldrin, dieldrin, endrin, DDT, hexachlorobenzene, chlordane, heptachlor, mirex, toxaphene, PCBs, dioxins and furans. Out of these 12, the first nine are mainly pesticides, extensively used in agriculture. PCBs and hexachlorobenzene are mostly used in industry and utility products. Dioxins and furans are unintentional by products in a large number of chemical, biological and thermal processes involving chlorine.

POPs and their Distribution

The widespread distribution of POPs across the world can be attributed to the following reasons:

POPs resist degradation due to chemical, biological and photolytic processes and are characterized by low solubility in water and high solubility in lipid resulting in bioaccumulation in fatty tissues of living organisms. POPs persist in the environment for a long time, with half-life ranging from several days to years and are semi-volatile. This creates favourable conditions for trans-boundary movements over long distances.

POPs Hot spots (developing countries)

Because of the acutely toxic nature, production and uses of most POPs (inclusive of PCBs, Lindane (BHC), DDT, aldrin, dieldrin and heptachlor) have already been banned in many countries, but their uses in developing countries are continuing unabatedly, particularly, DDT and Lindane (BHC). POPs hotspots are created at localized places largely due to lack of awareness among stakeholders; lack of proper legislation; lack of legally mandated institutions etc. all of which results in continued waste dumping around sites of municipal, industrial, hospital areas, as well as in areas where intensive agro-cultivation is practiced with indiscriminate use of pesticides.

About the Study

This study is about the identification of a POPs hot spot among vegetable growing areas whose products are sourced in to Kathmandu vegetable markets. The method consists of survey, analysis of residual pesticides in selected vegetable; assessing the results and preparing awareness-building materials related to the hotspot areas. Since residual pesticide analysis is cost intensive, only one vegetable item namely, potato was selected for sampling and analysis; and residual analysis of DDT and Lindane (BHC) have been conducted in each sample of potato, because in spite of being banned, these pesticides are considered to be extensively used in green vegetable and potato growing areas as well as during post-harvest treatment of the agro-products.

2.0 Study Phases

The study is divided into Phase I and Phase II activities. The former consists of inventory preparation of agricultural products that are sourced into vegetable markets of Kathmandu focussing mainly on demand and supply situation, determining residual levels of selected POPs in vegetable items, identifying product sources (commercial farms etc.) and preparing awareness building materials among stakeholders (farmers, common people, concerned agencies, media etc).

The later phase consists mainly of investigation of identified POP hotspot areas (contaminated soils, etc.) by analysing soil samples from where contaminated vegetable item is sourced into the markets; and preparing field based and other awareness building measures, in order to reduce the risk to human health and environment from possible POP exposure.

3.0 Phase I

3.1 Key Activities of Phase I

Key activities of the Phase I studies are:

- Survey and documentation of vegetable markets of Kathmandu with simple checklist on the supply of potentially POPs contaminated vegetable item (potato) and their locations with an objective to prepare an inventory of average supply and demand of the item.
- Collection of potato samples (15 to 20) for residual testing with details of type, date of collection, source area, supply volume of the season etc.
- POPs residual analysis in the collected samples at the laboratory for DDT and Lindane (BHC)
- Assessment of survey results and documentation.
- Preparation of mass awareness materials based upon scientific database.
- Conduction of mass awareness campaign.

3.2 Methodology

3.2.1 Survey and Documentation of Vegetable Markets of Kathmandu

Before proceeding with the market survey, checklists (Annex) were prepared focusing mainly on following points:

- Identification of principal vegetable market places in Kathmandu where different kinds of vegetable items (potato) are sourced from locations inside and outside Kathmandu.
- Identification of producers, suppliers, stockiest, and sellers of potato who can provide data / information on cropping seasons at different locations, potato growing areas in Nepal (sources for Kathmandu supply); types of potato grown;

the kind of disease vectors the farmers face during growing seasons and the types of pesticides they use to control the disease; types of preservative / pesticides stockiest use during storage.

- General awareness among farmers, field workers, and stockiest / retailers about the health risk posed by misuse / abuse of pesticides.
- General awareness among stakeholders on POPs, especially banned POPs such as, DDT / Lindane (BHC) because they are so persistent in the environment and acutely hazardous to health even at very low levels of exposures.
- Users' knowledge on the quality of the pesticides they use because often, the content of active ingredient in the supplied formulation may be far below the required level.
- Users' knowledge on the availability of other types of pesticides alternative to banned ones, which may be less harmful to health or forms of organic farming that completely avoids the use of pesticides altogether
- Preparation of lists of agencies (Government and non-Government) who keep databases on the potato production volume, locations where it is produced most, the places from where potato supply are sourced etc.

Since the ultimate aim of the study was to identify the POPs hot spot areas if any, a preliminary visit to main vegetable markets around Kathmandu (e. g. Kalimati, Balaju, Lagankhel, Baneswar, Koteswar, Tukucha etc) as well as some record keeping agencies was made. The purpose of the visit was to get a first hand knowledge on types of potato currently available (November / December); locations of sources; and to ensure that sampling points selected would not miss POPs-using areas, if any.

On the basis of preliminary study, survey visits were carried out to acquire data on supply sources from all over Nepal and outside Nepal, supply volumes, time of supply in to Kathmandu markets; along with information on types of pesticide farmers prefer to use in vegetable crops and their use practices, etc. This data was obtained from National Potato Development centre (HMG Organization), Khumultar. Data on records of annual potato entry in to Kathmandu from various districts of Nepal and places outside Nepal, source-wise and month-wise were obtained from Kalimati Fruits and vegetable Market Development Board, Kathmandu, which shows big supply sources and their time of supply.

During the survey, it was also observed that samples taken from retailers and stockiest for residual pesticide contents may not always be reliable regarding the sources from where they were supplied. So it was decided to visit some locations (farms), where the crops are ready for harvesting, take the samples and at the same time meet / talk to local people / farmers / farm owners about cropping patterns, fertilizers/ pesticides use practices etc.

3.2.2 Sample Taking for Residual Pesticide Analysis

Sampling Period: November 18 to December 16, 2004
Sample Size: Approximately 1 kg potato per sample

Sample Coverage: Locations around and outside Kathmandu Valley supplying their products to Kathmandu at the time of sampling as given in Table 1.

Table 1: Sample Coverage

S.No.	Source location	District / others	Sampled from	Number of samples collected
1	Bode	Bhaktapur	Field	2
2	Sankhu	Kathmandu	Market	4
3	Mulpani	Kathmandu	Field	1
4	Gothatar	Kathmandu	Field	2
5	Nala	Kavre	Market	1
6	Panauti	Kavre	Market	1
7	Panchkhal	Kavre	Market	1
8	Panchkhal	Kavre	Field	2
9	Bhakundebeshi	Kavre	Market	1
10	Trishuli	Nuwakot	Market	1
11	Bangali	Indian	Market	1

Out of 17 samples taken, 7 samples were taken from the field during harvest time and 10 from vegetable markets.

3.2.3 Sample Handling and Analysis

Nepal Environmental & Scientific Services laboratory was contracted for sampling handling and analysis by NEFEJ. All samples collected were placed in the refrigerator till the time of the analysis (usually the next day). Samples were taken out from the refrigerator, warmed to room temperature, chopped to small pieces along with skin and blended in a grinder to make pastes of potato samples. 100 gram of each sample was taken and extracted with acetonitrile with the addition of the filter aid, Celite- GR. After the addition of the extracting solvent, the sample mixture was then blended for at least two minutes to complete the extraction and then after, it was filtered through glass filter. The filtrate was transferred in to a 1000-ml capacity-separating funnel and then it was partitioned with petroleum spirit. The partitioned spirit layer was washed with water, and finally, the water content of the petroleum spirit was removed by anhydrous sodium sulphate. Then the extract was cleaned up in a Florisil column and eluted with a mixture of 6% diethyl ether in petroleum spirit. The eluate was then concentrated to a volume of 5 ml using a rotary evaporator. After the preparation of the sample, DDT and Lindane (BHC) were analysed by GLC using Electro Capture Detector. As a part of quality assurance fortified samples with DDT and Lindane were also analysed along with the samples.

The general conditions applied were:

GLC:	Chemito 8310
Detector:	ECD
Carrier gas:	Nitrogen
Column:	SE-30, Glass
Oven Temperature:	140^{o}C
Injector Temperature:	220^{o}C
Detector Temperature:	250^{o}C

3.3 Results and Findings

3.3.1 Demand and Supply situation of Potato in Kathmandu Valley

Demand and supply situation of potato in to Kathmandu valley markets in terms of annual total supply: in quantity, potato types, supply sources, supply times of the year etc are given in the following Tables: 2, 3, and 4.

Table 2: Annual Potato Supply in to Kathmandu Markets (metric tonne)

S.No.	Items	Year 2002/2003		Year 2003/2004		
		Total	Percentage	Total	Percentage	Mean
1	Red Potato	18963	67	18830	74	70.5
2	White Potato	9319	33	6662	26	29.5
	Total	**28282**	**100**	**25492**	**100**	100.0

Data source: Kalimati Fruits & Vegetables Market Development Board, Kalimati, Kathmandu

The above result shows that the annual total supply of potato in to the Kathmandu markets varies from 28292 (year: 2002 / 2003) to 25492 m.t. (year: 2003 / 2004), an average of 26887 m.t. per year. In the supplied tonnage, the supply of red variety amounts to an average of 70 % and the white variety to 30 %.

Table 3: Source-wise Distribution of Annual Potato Supplies into Kathmandu Markets with Rankings (in Metric Tonne)

		Year 2002/2003			Year 2003/2004		
S. No.	**Source**	**Total Metric Tonne**	**Rank**	**%**	**Total Tonne**	**Rank**	**%**
1	Bara District	57.91	12	0.20	311.61	8	1.22
2	Bhaktapur	968.62	5	3.42	347.42	7	1.36
3	Chitwan	1.44	17	0.01	10.25	15	0.04
4	Dhading	33.01	13	0.12	33.35	11	0.13
5	Gorkha	0	-	0	2.88	18	0.01
6	Jhapa	558.59	7	1.98	484.38	6	1.90
7	Kathmandu	6553.61	2	23.17	5208.41	2	20.43
8	Kavre	14961.28	1	52.90	13542.69	1	53.13
9	Lalaitpur	30.55	14	0.11	12.72	14	0.05
10	Makawanpur	727.51	6	2.57	789.82	4	3.10
11	Nuwakot	298.69	8	1.06	569.55	5	2.23
12	Nawalparashi	10.80	16	0.04	0	0	
13	Parsha	1382.75	4	4.89	263.74	9	1.03
14	Rautahat	0			3.56	17	0.01
15	Sarlahi	30.17	15	0.11	5.00	16	0.02
16	Sunsari	175.34	8	0.62	100.30	10	0.39
17	India	2255.00	3	7.97	3722.71	3	14.60
18	Tibet	88.60	9	0.31	22.00	13	0.09
19	Bhutan	81.10	10	0.29	0	0	
20	Others	67.50	11	0.24	61.65	12	0.24
	Total	28282.47		100.00	25492.04		100.00

Data source: Kalimati Fruits & Vegetables Market Development Board, Kalimati, Kathmandu

The above data shows that more than 20 different sources from inside and outside Nepal supply potato in to Kathmandu markets. The supply sources are: 16 districts of Nepal, unknown locations from India, Bhutan and Tibet and others.

In terms of supply quantity, Kavre district of Nepal ranks first supplying about 53 % of the total; Kathmandu district supplies about 22 %; and the supply from India ranks third, about 11 %.

Table 4: Month-wise Distribution of Annual Potato Supplies in to Kathmandu Markets with Rankings (in metric tonne)

Year 2002/2003				Year 2003/2004			
Rank	**Months**	**Supply**	**%**	**Rank**	**Months**	**Total**	**%**
1	Aswin (Sept/Oct)	2801.54	9.91	1	Falgun (Feb/March)	2630.81	10.3
2	Chaitra (March/April)	2800.08	9.90	2	Chaitra (March/April)	2350.16	9.2
3	Bhadra (Aug/Sept	2772.146	9.80	3	Bhadra (Aug/Sept	2238.31	8.8
4	Falgun (Feb/March)	2724.49	9.63	4	Baishak (April/May)	2200.74	8.6
5	Mansir (Nov/Dec)	2663.06	9.42	5	Jestha (May/June)	2198.72	8.6
6	Poush (Dec/Jan)	2427.38	8.58	6	Aswin (Sept/Oct)	2123.9	8.3
7	Magh (Jan/Feb)	2221.99	7.86	7	Magh (Jan/Feb)	2116.48	8.3
8	Baishak (April/May)	2159.61	7.64	8	Kartik (Oct/Nov)	2101.14	8.2
9	Sharwan (July/Aug	2079.825	7.35	9	Mansir (Nov/Dec)	2050.00	8.0
10	Aasad (June/July)	2045.82	7.23	10	Poush (Dec/Jan)	1985.36	7.8
11	Jestha (May/June)	1879.39	6.65	11	Aasad (June/July)	1840.86	7.2
12	Kartik (Oct/Nov)	1707.08	6.04	12	Sharwan (July/Aug	1655.56	6.5
	Total	**28282.41**	**100.00**			**25492.03**	**100.0**

Data source: Kalimati Fruits & Vegetables Market Development Board, Kalimati, Kathmandu

Data from above table shows that in terms of monthly supplies, the quantities of supply is almost uniform, low supply months can be taken as Zestha, Asar, and Shrawan; high supply months Magh, Fagun, and Chaitra.

3.3.2 Potato Cultivation and Use of Chemicals

Information gathered from the concerned people indicate that depending upon the type of location of the potato growing areas, multiple crops of potato are grown, usually twice a year, each cropping season lasting about two to three months. Most samples of potato collected for this study (November-December, harvesting season) were harvested a little more than two months after seeding. During the sample taking in the field, it was revealed that farmers apart from using conventional chemical fertilizers also used a certain kind of bio-fertilizer to hasten potato growths, shortening the growing season.
But farmers on the ground were reluctant to tell about the kind of specific pesticides they use.

While talking about the pesticide use practices in vegetables including potato, with people from Government organizations, like the Crop Protection Department and National Potato Development Centre, they say that DDT and Lindane (BHC) are banned items, as such, these pesticides are not available in the market and farmers in general do not use them for crop protection

Some Details About Potato Samples Collected and Analysed
Seeding Time: Bhadra

Harvesting Time: 60-62 days after seeding

Manure/Fertilizer used: Chicken litter/ |Organic Manure /Urea/ DAP, in cases where the soil is acidic, agricultural lime is also applied to the soil. In addition to the above, farmers also prefer to use bio-fertilizers.

Among the Pesticides / Fungicides used:
Pesticides: Furadan 3G (Carbofuran 3% G); Cartap Hydrochloride 4 % G (Kritap 4 G Insecticide); Phorate 10% CG;

Pesticide use practices: The above pesticides are normally used for soil conditioning and during cropping time.

Fungicides: (Mancozeb 75 %); Dithanem M 45; Indofil M 45; Artee M 45; Saviorm 45; Uthane 45; Dhankaka M 45; Anu M 45.

Use-Practices:
Fungicides are used only during potato cropping time.
Spraying Time: 3 – 7 days interval (during cropping time)

3.3.3 Results of Chemical Analysis of Residual Pesticides

The results of chemical analysis of residual pesticides are given in Table 5.

Table 5: Residual Pesticide Contents in Potato Samples

No.	Locations	Date	Observed Residual Pesticide Concentration, (ppm)				
			DDT	α-Lindane (BHC)	β-Lindane (BHC)	γ-Lindane (BHC)	δ-Lindane (BHC)
1.	BKT-Bode-4	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	**0.002**	N. D. (<0.001)
2.	BKT-Bode-5	23 - 11 - 2004	**0.016**	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
3.	Sankhu Nilo - 6	19 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
4.	Gothatar - 1	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
5.	Gothatar - 2	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
6.	Mulpani - 3	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
7.	Sankhu Seto	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	**0.001**	N. D. (<0.001)	N. D. (<0.001)
8.	Indian Bangali	18 - 11 - 2004	**0.041**	N. D. (<0.001)	N. D. (<0.001)	**0.001**	N. D. (<0.001)
9.	Nala Lamo Rato	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
10.	Panauti Golo rato	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
11.	Sankhu Rato	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
12.	PanchKhal-1	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
13.	Panchkhal-Anekote-4/5 (Bari)	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
14.	Panchkhal (Bari) - 2	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
15.	Bhakundebesi	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
16.	Sankhu (Re sample)	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
17.	Trisuli Dhikure	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)

Note: α- Lindane (BHC), β-Lindane (BHC), γ-Lindane (BHC), and δ-Lindane (BHC) are isomers

The above results of residual pesticides analysis indicates that out of 17 potato samples analysed, only four samples showed some residual pesticide levels above the detection limits (D.L. = less than 0.001 mg / kg) of the equipment under the specified operating conditions. The residual contents of sample number 1 (BKT-Bode-4) and sample number 7 (Sankhu Seto) are barely above the D.L. for γ-Lindane (BHC) and β-Lindane (BHC) respectively. Residual DDT contents obtained for sample 2 (BKT-Bode-5) and sample 8 (Indian Bengali) are 0.016 mg / kg and 0.041 mg / kg respectively.

3.3.4 Comparison of Residual Data Obtained with Standards

Nepal Standards

According to Nepal Standards (Rajpatra, Volume 50, Magh 23, 2057; Number 42), Pesticide residue limit of DDT in food grains (cereals) is absent (no further elaboration on the word absent is given)

Residue limit of Lindane (BHC) in food grains (cereals) is 0.01 mg / kg.

Indian Standards (Ref. Source: A.T. Dudani, 1987)
Residue limits of DDT and Lindane (BHC) in potato are not available.
Residue limit of DDT in milk and baby foods is 1.25 mg / kg.
Residue limit of Lindane in eggs is 0.1 mg / kg.

Codex FAO
Residue limits of DDT and Lindane (BHC) in potato are not available.
Residue limit of DDT in cereal grains is 0.1 mg / kg
Residue limit of DDT in milk is 0.02 mg / kg.
Residue limit of DDT in eggs is 0.1 mg / kg.
Residue limit of aldrin, dieldrin, and chlordane in cereals is 0.02 mg / kg.

Comparison of Study Data, DDT

Since no standards for DDT or Lindane in potato were available for comparison, the data was compared with standards established for cereals, milk, baby foods, and eggs. The residue values obtained in potato (0.016 mg / kg for sample NO. 2; and 0.041 mg / kg for S.NO 8) indicate the presence of DDT and therefore exceeded standards for cereals in Nepal. The DDT values in the two Nepali potatoes were lower than the Indian Standard limits of 1.25 mg/ kg in milk and baby foods. Both samples were lower than the Codex standard of 0.1 mg / kg in cereal grains and eggs but the potato value for Sample N0. 8 exceeded the Codex standard for milk (0.02 mg / kg).

Comparison of Study Data, Lindane (BHC)

Lindane (BHC) residue values obtained in potato (S.N.1 and S.N. 2) are lower than the Nepal Standard limit of 0.01 mg/kg established for food grains.

Comprehensive reports on past studies carried out to determine residual pesticides contents in foodstuff are rare. However, results of some studies indicate the following:

DDT residue analysis carried out in Central Food Research Laboratory in the 1980s indicates that most of the food items analysed at that time were found to be contaminated by DDT, but it was said that decreasing trend of DDT contents in foodstuff was observed in analyses conducted in subsequent years.

In a study carried out in 1994, similar analyses of DDT, Lindane (BHC) and other pesticides were performed in 15 samples of food grains (by GLC, using ECD, samples were sent to India for residue analysis) and it is reported that in none of the samples analysed, DDT, Lindane (BHC) and other pesticides were found above the detection limits, D. L. lower than 0.001 mg / kg),

3.3.5 Assessment of Results

While assessing the laboratory data on residue contents of potato samples, it becomes clear that about 18 % of the sample examined showed some residue contents of DDT and Lindane (BHC). Although the experimental values obtained for potato could not be compared directly with other standards for lack of standard potato values, the overall indication is that DDT and Lindane (BHC) values obtained for domestic potato may not be high enough to cause immediate health concerns to potato consumers or to the environment, which is contrary to the earlier expectation.

No matter how low the concentration is the bio accumulative and persistent character of POPs increases the risk of build-up of these chemicals in the body of the consumers if the contaminated vegetable items are consumed regularly for a long period of time. From this angle, the low observed concentration of POPs does not ensure health and environmental safety. To ensure that the POPs are not used intentionally, legal instruments are important to be further supported by regular monitoring backups. The current low levels of analysed POPs in potatoes as shown by the documented records of the past, is a result of banning POPs in Nepal (Joshi, 1984).

3.3.6 Possible Reason for the Study Outcome

Types of Pesticide Used by the Farmers

Field survey result (see 3.3.2 above) on the types of pesticide used indicated that most farmers do not seem to use DDT and Lindane (BHC) during potato cultivation. Instead, they use fungicide (75 % Mancozeb) for the protection of above ground crops by regular spraying. The types of pesticides (other that DDT and Lindane (BHC)) they use both for soil conditioning and during potato cropping have been described in earlier section (3.3.2). If this is the case, the low values of DDT and Lindane (BHC) obtained for some samples can be expected.

Application of agro-pesticides per Hectare of land in Nepal and some Asian countries.

Country	Pesticides (gram/Ha)	Active ingredient (gram/Ha)
Nepal	142	26
Bangladesh	750	160
Pakistan	1000	310
Indonesia	1100	400
Thailand	1200	400
Malaysia	6500	1600

Source ADB, 1987

The above data indicates that pesticides application per hectare of land in Nepal is comparatively much lower. Currently even if the application rate is increased by several-fold the quantity applied per hectare is expected to be much lower than for Bangladesh.

Both above factors may contribute to lower residue values, as has been the case.

However, there are some obvious limitations of the study:

The Sample Size and Coverage

As said earlier, 16 samples were taken whose sources covered four districts of Nepal namely, Kavre, Kathmandu, Bhaktapur and Nuwakot (excluding the one from India). The areas covered by potato cultivation in each district are as follows:

Kavre: 14961 Ha; Kathmandu: 6553 Ha; Bhaktapur: 968 Ha; and Nuwakot: 298 Ha, a total of 22780 Ha of land (Source: Kalimati Fruits and Vegetable Market Development Board). From the above data, the area covered by each sample comes to 1611 Ha. of land. The above sample coverage may not adequately represent all potato growing areas in terms of location specifics, soil conditions, and above all pesticide use practices followed by potato growers and thus, possibly may have skipped some high pesticide using locations.

Seasonal variations are not covered. This report is based upon one season coverage. For a representative study, all seasons should have been covered.

About the Phase II Study

The basic aim of the Phase II study was to identify hot spot agricultural areas, if any with respect to POPs (DDT and Lindane (BHC)) from the pesticide residue contents in potato analysed/examined in the Phase I study.

It has been described earlier in this report that only three domestic samples showed some residual values of DDT and Lindane (BHC) above the detection limits (0.001mg/kg) which points to the fact that the Phase II activities should concentrate more on those three particular locations whose potato product were sourced in to the Kathmandu vegetable markets, and which were sampled and analysed.

Accordingly, those source location will be visited and at the same time more information on the present and past history about the POPs pesticide use pattern in those and adjoining areas will be made; soils samples taken for subsequent laboratory analysis of residual DDT and Lindane (BHC) contents.

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3. Joshi, DDT Residue in Food Commodities in Nepal, Proceeding of the first Nepal Seminar on Food Industries and Food Technology, 1984.
4. Monitoring of DDT residue in Food Articles of Nepal, Proceedings of National Conference on Science and Technology (RONAST), 1988.
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Annex 1:

Checklist for Inventory of Agricultural Products that are sourced in to the Vegetable Market of Kathmandu Valley

Visit to main vegetable market places in the Kathmandu: Kalimati, Kalanki. Balkhu, Lagankhel, Balaju, Chabahil, Dillibazar, Ason, etc.

Visit to vegetable (potato) distributors: Name; Address:

How long have you been in this business (years)?

Who are your main potato suppliers? Give Name / address of the farm / Farmers / Cold Storage

Give Quantity supplied by each supplier (packs of 50-kg) in each growing season

Give total quantity of potatoes received / sold (nos. of 50-kg packs) by you per year.

Do you receive potatoes, treated with preservatives, from your suppliers? If so by whom, in what quantity, in what season? And what are the names of the preservatives used?

Have you got your own cold storage / places of storage? If so give the capacity, quantity stored, period of time generally stored before selling, and what preservative do you use?

In your opinion, how many trucks or vehicle loads of potatoes (Nos. of 50-kg packs) enter the valley from outside, daily? and from where?

In your opinion, which of the producers produce the best potato in quality and quantity?

In your opinion, which of the suppliers generally supply treated potatoes and from where and when?

Among the vegetable items other than potato, which items are sold in the Kathmandu market mostly containing preservatives?

Questionnaire to knowledgeable person / authority

Give the names / locations of potato growing areas / farms which supply the produce in to the Kathmandu vegetable market.

Give an idea of potato supply situation in Kathmandu in terms of quantity supplied by growing location in each season and in each year. Total Supply figure in to Kathmandu per year?

Which time of the year, in which the supply is lean, do you think the potato sent in to the Kathmandu market can become contaminated with preservatives? Or is it the usual practice that residual amount of preservative may always be present in marketed potatoes?

What pesticides are generally used by farmers / growers in the field or during post-harvest storage?

Potato coming from Indian farmers is said to contain prohibited organochlorines (e.g. Lindane (BHC), DDT). Even growers in Nepal use such banned pesticides. How far do you agree with this?

Annex 2: National Wide Cultivation Area and Production of Potato

S.N.	District	Area (ha)	Production (MT)	Productivity (MT/ha)
Eastern Region				
1.	Taplegung	3600	40450	11.24
2.	Panthar	4265	4666	1.09
3.	Ilam	6716	89686	13.35
4.	Jhapa	10000	200000	20.00
5.	Sankhuwashawa	1320	30917	23.42
6.	Terathum	1800	13500	7.50
7.	Bhojpur	2310	18400	7.97
8.	Dhankuta	1978	29452	14.89
9.	Morang	5101	60701	11.90
10.	Sunsari	3000	49500	16.50
11.	Solokhumbu	9095	118235	13.00
12.	Okaldhunga	2765	30945	11.19
13.	Khotang	3300	38910	11.79
14.	Udayapur	704	1684	9.92
15.	Saptari	4750	85500	18.00
16.	Siraha	1205	12650	10.50
	Sub Total	**61909**	**830496**	**13.41**
Central Region				
1.	Dholakha	2430	21263	8.75
2.	Ramechap	3035	33628	11.08
3.	Sindhuli	1520	18754	12.34
4.	Dhanusha	1850	20350	11.00
5.	Mahottari	3200	28000	8.75
6.	Sarlahi	1200	18000	15.00
7.	Rasuwa	2515	31400	12.49
8.	Dhading	1573	20549	13.06
9.	Nuwakot	1800	19650	10.92
10.	Sindhupalanchowk	4030	58435	14.50
11.	Kavre	4250	87230	20.52
12.	Kathmandu	2225	34946	15.71
13.	Bhaktapur	1050	18375	17.50
14.	Lalitpur	900	12900	14.33
15.	Chitwan	1750	23375	13.36
16.	Makawanpur	4524	25102	5.55
17.	Parsa	965	11910	12.34
18.	Bara	6064	13993	2.31
19.	Rautahat	6010	43526	7.24
	Sub Total	**50891**	**541386**	**10.64**
Western Region				
1.	Gorkha	2345	27106	11.56
2.	Tanahu	689	6514	9.45
3.	Manag	730	8545	11.71
4.	Lamjung	1690	20280	12.00
5.	Kaski	957	9865	10.31

6.	Syanja	750	15000	20.00
7.	Parbat	1355	12450	9.19
8.	Myagdi	1470		00.00
9.	Mustang	232	2308	9.95
10.	Baglung	1270	19304	15.20
11.	Gulmi	345	3524	10.21
12.	Aargakhanchi	607	6100	10.05
13.	Palpa	680	7752	11.40
14.	Nawalparasi	875	8962	10.24
15.	Rupenehi	3255	58500	17.97
16.	Kapilbastu	1875	12500	6.67
	Sub Total	**19125**	**218710**	**11.44**

S.N.	**District**	**Area (ha)**	**Production (MT)**	**Productivity (MT/ha)**
Mid Western Region				
1.	Rukum	1585	15850	10.00
2.	Rolpa	1475	15635	1060
3.	Syallan	1160	13900	11.98
4.	Piuthan	840	8770	10.44
5.	Dang	6950	22425	3.23
6.	Dailekh	676	8676	12.83
7.	Jajarkot	610	5220	8.56
8.	Surkhet	545	9950	18.26
9.	Banke	1585	15850	10.00
10.	Bardiya	1950	38498	19.74
11.	Jumla	2735	37350	13.66
12.	Dolpa	427	4700	11.01
13.	Kalikot	1000	10050	10.05
14.	Mugu	602	4452	7.40
15.	Humla	589	6157	10.45
	Sub Total	**22729**	**217483**	**9.57**
Far western Region				
1.	Bhaghang	2950	23600	8.00
2.	Bajura	450	2500	5.56
3.	Doti	654	8892	13.60
4.	Acham	385	3007	7.81
5.	Kailali	1240	13100	10.56
6.	Darchula	860	6300	7.33
7.	Dadheldhura	435	5616	12.91
8.	Baitadi	612	5715	9.34
9.	Kanchanpur	1406	18278	13.00
	Sub Total	**8992**	**87008**	**9.68**
	Grand Total	**163646**	**1895083**	**11.58**

Source: National Potato Development Centre, Khumaltar, Lalitpur (2060/2061)

Attachment 2

Second Phase Report

IDENTIFICATION OF POPs HOT SPOT – Examination of DDT and Lindane (BHC) Residues in Potato and Farm Soil

Table of Contents

1. Introduction

The study intends to analyse POPs residue levels in the vegetable items and the agricultural farm soil whose products are sourced into vegetable markets. The method consists of survey, analysis of residual pesticides in selected vegetable item and the soil of the source farm area.

The study is based on the Kathmandu vegetable market and the source areas supplying vegetable products to Kathmandu vegetable market. The vegetable item selected was potato. The targeted POPs for residue analysis are DDT and Lindane (BHC). Vegetable item Potato is selected because it is one of the most consumed vegetable item in Kathmandu and is used by the cross cutting groups of consumer (economic and ethnic). DDT and Lindane (BHC) POPs were selected because they are reported to have extensive use in the vegetable agricultural farms which supply vegetable items to Kathmandu.

The study is divided in to Phase I and Phase II. The Phase I study consists of inventory preparation of vegetable item potato sourced into vegetable markets of Kathmandu focusing mainly on demand and supply situation, identifying product sources (commercial farms etc.) and determining residual levels of DDT and Lindane (BHC) POPs in potato.

The Phase II consists mainly of investigation of identified DDT and Lindane (BHC) POPs contaminated potato farm areas and analysing soil samples from where contaminated potato item is sourced into the markets.

The aim of the study was to identify the POPs hotspot area among the vegetable growing areas in Nepal with an objective to involve common grass root people and NGOs in the Global POPs eliminations campaign through awareness programs about the POPs that are being used in their environment.

2. Summary of Phase I Study

The Phase I study was accomplished in the January 2005 and its results were already submitted in the form of a technical report. The findings of the study were disseminated to the media and common people in a series of interaction meetings.

Main activities conducted were:

- Survey and documentation of vegetable markets of Kathmandu with simple checklist on the supply of potentially POPs contaminated vegetable item (potato) and their locations with an objective to prepare an inventory of average supply and demand of the item.
- Collection of potato samples (17) for residual testing with details of type, date of collection, source area, supply volume of the season etc.
- POPs residual analysis in the collected samples at the laboratory for DDT and Lindane (BHC)
- Assessment of survey results and documentation of findings.

- Interaction meetings with the media, and people to disseminate the information

2.1 Sample Coverage

Locations around and outside Kathmandu Valley supplying their products to Kathmandu at the time of sampling were as given in the Table 1 below:

Table 1: Potato supply source areas, Kathmandu

S. N	Source location	District / others	Sampled from	Number of samples collected
1	Bode	Bhaktapur	Field	2
2	Sankhu	Kathmandu	Market	4
3	Mulpani	Kathmandu	Field	1
4	Gothatar	Kathmandu	Field	2
5	Nala	Kavre	Market	1
6	Panauti	Kavre	Market	1
7	Panchkhal	Kavre	Market	1
8	Panchkhal	Kavre	Field	2
9	Bhakundebeshi	Kavre	Market	1
10	Trishuli	Nuwakot	Market	1
11	Bangali	Indian	Market	1

Out of 17 samples taken, 7 samples were taken from the field during harvest time and 10 from vegetable markets.

2.2 Sample Analysis and Results

All samples collected were analysed for the residual contents of DDT and Lindane (BHC) by using GLC with ECD (Electro Capture Detector) at the laboratory of Nepal Environmental & Scientific Services, Kathmandu Nepal. The analysis results are presented in Table 2.

Table 2: Residual Pesticide Contents in Potato Samples

No.	Locations	Date	Observed Residual Pesticide Concentration, (ppm)				
			DDT	**α- Lindane (BHC)**	**β-Lindane (BHC)**	**γ-Lindane (BHC)**	**δ-Lindane (BHC)**
1.	BKT-Bode-4	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	**0.002**	N. D. (<0.001)
2.	BKT-Bode-5	23 - 11 - 2004	**0.016**	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
3.	Sankhu Nilo - 6	19 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
4.	Gothatar - 1	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
5.	Gothatar - 2	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
6.	Mulpani - 3	23 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
7.	Sankhu Seto	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	**0.001**	N. D. (<0.001)	N. D. (<0.001)
8.	Indian Bangali	18 - 11 - 2004	**0.041**	N. D. (<0.001)	N. D. (<0.001)	**0.001**	N. D. (<0.001)
9.	Nala Lamo Rato	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
10.	Panauti Golo rato	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
11.	Sankhu Rato	18 - 11 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
12.	PanchKhal-1	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
13.	Panchkhal-Anekote-4/5 (Bari)	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
14.	Panchkhal (Bari) - 2	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
15.	Bhakundebesi	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
16.	Sankhu (Re sample)	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)
17.	Trisuli Dhikure	16 - 12 - 2004	N. D. (<0.005)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)

Note: α- Lindane (BHC), β-Lindane (BHC), γ-Lindane (BHC), and δ-Lindane (BHC) are isomers

The results of residual pesticides indicated that out of 17 samples analysed, only four samples showed some residual pesticide levels above the detection limits (D.L.= 0.001 mg / kg) of the equipment under the specified operating conditions.

The residual contents of sample number 1 (BKT-Bode-4) and sample number 7 (Sankhu Seto) were barely above the D.L. for γ-Lindane (BHC) and β-Lindane (BHC) respectively. Residual DDT contents obtained for sample 2, from Bhaktapur, Bode (BKT-Bode-5) and sample 8 (Indian Bengali) were 0.016 mg / kg and 0.041 mg / kg respectively.

2.3 Phase I findings

- The survey result showed that the annual total supply of potato in to the Kathmandu markets came to about 26887 Mt. (average for 2059/2060). In the supplied tonnage, the red variety amounts to an average of 70 % and the white variety to 30 %.
- There were more than 20 different sources from inside and outside Nepal who supplied potato in to Kathmandu markets. They were 16 districts of Nepal; unknown locations from India, Bhutan and Tibet; and others. In terms of supply quantity, Kavre district of Nepal ranked first supplying about 53 % of the total; Kathmandu district supplying 22 % ranked 2nd; and India supplying 11% ranked third.
- While talking about the pesticide use practices in vegetables including potato, with people from Government organizations, they say that DDT and Lindane (BHC) are banned items, as such, these pesticides are not available in the market and farmers in general do not use them for crop protection. Farmers themselves were not open to discussion on the type of insecticides they use in potato crops.
- Information gathered from dealers/sellers of insecticides indicated the following use practices:
- Furadan 3G (Carbofuran 3% G); Cartap Hydrochloride 4 % G (Kritap 4 G Insecticide); Phorate 10% CG;
- Fungicides (Mancozeb 75 %)
- Dithanem M 45; Indofil M 45; Artee M 45; Saviorm 45; Uthane 45; Dhankaka M 45; Anu M 45.
- While assessing the laboratory data on residue contents of potato samples, it shows that about 18 % of the sample examined showed some residue contents of DDT and Lindane (BHC).
- A comparison of study data, DDT with international standards, The residue values obtained in potato (0.016 mg / kg for sample NO. 2; and 0.041 mg / kg for S.NO 8) are lower when compared with Codex value of 0.1 mg / kg in cereal grains and eggs. The above described sample DDT values are still lower compared to Indian Standard limits of 1. 25 mg / kg in milk and baby foods, But in comparison to Codex value in milk (0.02 mg / kg), the potato value for Sample N0. 8 are at higher level.

- A comparison of study data, Lindane (BHC) with international standards shows that Lindane (BHC) residue values obtained in potato (S.N.1 and S.N. 2) are much lower compared to Codex values for aldrin, dieldrin chlordane in cereals (0.02 mg / kg). No potato standard values are available for direct comparison.
- Reports on past studies on residual DDT in foods carried out in Central Food Research Laboratory (Government body) in 1980s indicated that most of the food items analysed at that time was found to be contaminated by DDT. Similar study carried out in 1994 for residual contents in 15 samples of food grains (by GLC, using ECD, samples were sent to India for residue analysis), it was reported DDT, Lindane (BHC) and other pesticides were not found above the detection limits (D. L. lower than 0.001 mg / kg).
- Although the experimental values obtained for potato could not be compared directly with other standards for lack of standard potato values, the overall indication is that DDT and Lindane (BHC) values obtained for domestic potato may not be high enough to cause health concern to potato consumers or to the environment.

3.0 Phase II Study

The phase II study is a follow up study for the investigation of source areas from where the potatoes produce were brought for marketing to Kathmandu. These include source areas comprising both DDT- and Lindane (BHC)-contaminated and not contaminated agro produces. The investigation has a duel propose. The first propose is to investigate whether or not the source area soil shows appreciable contamination of the target POPs as shown by the potatoes grown in the farm. The second purpose is to confirm whether the agro produce of the farm and soil of the farm shows comparable results for the identification of agricultural farms that could be considered POPs hot spot.

3.1 Main activities carried out

- Identification of soil sample coverage and area coverage based on the results of Phase I study
- Identification of soil sample withdrawal technique
- Soil sample taking from identified spots / areas
- Chemical Analysis of DDT and Lindane (BHC) in sampled soils using Gas Chromatograph and ECD detector
- Assessment of result

Each soil sample was usually a composite soil taken from several locations of one area. The composite soil sample is prepared following the best practice coning and quartering method. The quantity of the composite soil for analysis is 1 kg.

The total number of soil samples taken was 16 and the area covered by the study incorporated four districts namely Kathmandu, Lalitpur, Bhaktapur, and Kavre, sourcing

nearly 75% of the potato supply to Kathmandu. The number of samples taken from each district was respectively: 7, 1, 3 and 5.

3.2 Potato Cultivation and Use of Chemicals

Information gathered from the concerned people of the agricultural farm indicate that depending upon the type of location of the potato growing areas, multiple crops of potato is grown, usually twice a year, each cropping season lasting about two to three months. During the sample taking in the field, it was revealed that farmers were using DDT and Lindane (BHC) extensively for the pest protection. But since the last 10 to 15 years, they are not using DDT and Lindane (BHC). These pesticides have been replaced by other pesticides; however, farmers on the ground were reluctant to tell about the kind of specific pesticides they use.

3.3 Determination of DDT and Lindane (BHC) Residue in Soil Samples

Laboratory of Nepal Environmental and Scientific Services, Kathmandu, Nepal was contracted for sample collection, handling and analysis. All samples collected were placed in the refrigerator till the time of analysis (usually till the next day).

Samples were taken out from the refrigerator, and cooled to room temperature. Twenty-five grams of undried sample sieved through 2mm sieve was taken in 250 ml Erlenmeyer flask and 17.5 ml 0.2N ammonium chloride solution was added to the soil. The mixture was shook for few seconds and it was stand for fifteen minutes. 100 ml of hexane acetone mixture (1+1) was added to the sample and it was shook by wrist for twelve hours.

The clear supernatant was passed through the Florisil column collecting the eluate in one-litre separatory funnel. The residue was washed with two portions of 25-ml hexane - acetone mixture. Finally, the column was rinsed with 10-ml hexane acetone mixture. The washing was also passed through the Florisil column collecting the eluate into the same flask.

200-ml water was added to the separatory flask and shook for 30 seconds. The aqueous layer was transferred into the second separatory flask and was extracted with 50 ml hexane. Both the extracts were combined and passed through sodium sulfate layer to remove moisture. At last the extracts were concentrated and final volume was adjusted to 5 ml with acetone. Determination of Lindane (BHC) and DDT was carried out by GC-ECD system. The conditions applied are as follows:

GLC:	Chemito 8510
Detector:	ECD
Carrier Gas:	Nitrogen
Column:	SE-30, Glass
Oven Temp:	140oC

Injector Temp: 220oC
Detector Temp: 250oC

As a part of quality assurance fortified sample with DDT and Lindane were also analysed along with the samples

3.4 Results of Chemical Analysis

Table 3 presents the obtained results of the soil residue analysis of the agricultural farms of the four districts, which supply nearly about 75% of the potato demand of Kathmandu vegetable market.

Table 3: Residual Pesticide Contents in Potato Samples

S.N.	Location	Observed Residue level in ppm				
		a Lindane (BHC)	**β Lindane (BHC)**	**γ Lindane (BHC)**	**δ Lindane (BHC)**	**DDT**
1.	Gothatar - Kathmandu	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
2.	Mulpani - Kathmandu	N. D. (<0.001)	N. D. (<0.001)	**0.001**	N. D. (<0.001)	N. D. (<0.005)
3.	Bode - Bhaktapur	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
4.	Bode - Bhaktapur	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
5.	Bode - Bhaktapur	**0.001**	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
6.	Nala - Kavre	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
7.	Nala - Kavre	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
8.	Hokse Panchkhal - Kavre	**0.001**	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
9.	Hokse Panchkhal - Kavre	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
10.	Panchkhal - Kavre	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
11.	Gokarna - Kathmandu	N. D. (<0.001)	N. D. (<0.001)	**0.002**	N. D. (<0.001)	N. D. (<0.005)
12.	Gokarna - Kathmandu	**0.001**	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
13.	Indrayani - Kathmandu	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)

14.	Sankhu - Kathmandu	N. D. (<0.001)	N. D. (<0.001)	**0.001**	N. D. (<0.001)	N. D. (<0.005)
15.	Sankhu - Kathmandu	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)
16.	Imadole - Lalitpur	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.001)	N. D. (<0.005)

The results indicated that DDT and Lindane (BHC) in most soils analysed for residue are below the instrument detection limits. Altogether, 6 composite soils (three from Kathmandu, one from Kavre and two from Bhaktapur) showed some indications of Lindane (BHC) at levels of detection. While none of the soil samples indicated DDT contamination above the instrumental detection limit.

US EPA (1999) gives Maximum Residual Level (MRL) of environmental and ecological concern in soil for DDT and Lindane (BHC) as 0.053 and 0.023 ppm respectively. Since the residual concentration observed for the analysed soil samples are far below the above MRL values for DDT and Lindane (BHC) POPs, the agricultural farm under investigation are safe from environmental and ecological consideration. However, since these areas were under DDT and Lindane (BHC) application some 10 to 15 years before, there is potential of some localized areas of high concentration above MRL value.

4. Comparative Assessment of Residue Results of DDT and Lindane (BHC) in Soil and Potato Samples

Table 4 presents comparative residue levels of DDT and Lindane (BHC) in soil and potato samples of the study area. Invariably the potato samples showing contaminations of Lindane (BHC) at instrumental detection limit shows contamination of Lindane (BHC) in soil, but the contaminant Lindane (BHC) isomer in the soil and potato may differ. However, a distinct relationship between the residue level in soil and potato and vice versa is not a general rule. More sample analysis may be required to investigate the above relationship. The obtained results, however, do indicate that even the contaminations of POPs below the detection limits of the instrument have higher probability of enrichment of the POPs contaminant in the residue of agricultural produce above the instrumental detection limit. DDT residue level and β Lindane (BHC) and γ Lindane (BHC) residue levels in the analysed potato samples at least indicate the above contention.

Table 4: Comparison of DDT and Lindane (BHC) data obtained for Soil and Potato Samples

Potato sample No (rf. Table 2) (1)	Soil Sample No (rf. Table 3) (2)	District (3)	Location of Soil Samples (4)	Observed Residue level for DDT & Lindane (BHC) in soil (PPM) (5)	Observed Residue level for DDT & Lindane (BHC) in corresponding potato samples (PPM) (6)	Remarks (7)
4 & 5	1	Kathmandu	Gothatar	ND	ND	
6	2	Kathmandu	Mulpani	γ Lindane (BHC) 0.001	ND	
	13	Kathmandu	Indrayani	ND	ND	New area
7, 11 & 16	14	Kathmandu	Sankhu	γ Lindane (BHC) 0.001	β Lindane (BHC) 0.001 (7)	
	15	Kathmandu	Sankhu	ND		
	11	Kathmandu	Gokarna	α Lindane (BHC) 0.002		New area
	12	Kathmandu	Gokarna	γ Lindane (BHC) 0.001		
1 & 2	3	Bhaktapur	Bode	ND	(1) γ Lindane (BHC) 0.002 (2) DDT 0.016	
	4	Bhaktapur	Bode	ND		
	5	Bhaktapur	Bode	α Lindane (BHC) 0.001		
9 & 10	6	Kavre	Nala	ND	ND	
	7	Kavre	Nala	ND		
12, 13 & 14	8	Kavre	Hokse - Panchkhal	α Lindane (BHC) 0.001	ND	
	9	Kavre	Hokse - Panchkhal	ND		
	10	Kavre	Hokse - Panchkhal	ND		
	16	Lalitpur	Imadol-4	ND		New area

NB: - The value written inside ( ) in column (6) represents Potato Sample Number of Potato Analysis Report.

5. Findings and Conclusions

The potato source area of Kathmandu vegetable market under investigation has been under application of DDT and Lindane (BHC) in the past. Since the last 10 to 15 years, the DDT and Lindane (BHC) pesticides are not reported to be used. The DDT and Lindane (BHC) residual analysis carried out during this study in the vegetable item (potato) and soil do not show residual levels above MRL values of environmental and ecological concern. However, the bio accumulative and persistent properties of POPs result in high concentrations in living things despite low initial environmental concentrations. As there are no quantitative database on the application of DDT and Lindane (BHC) in the past and its actual area coverage, it is not possible to ascertain the entire agricultural farms as environmentally and ecologically safe from the above POPs. However, the obtained DDT, Lindane (BHC) residual analysis results of potato and farm soil reveals that the coverage of the contaminated POPs hotspot, if any, is limited to small localized pockets only. Such potential localized POPs hotspot pocket area could be confined to areas where eroded sediments from the DDT, Lindane (BHC) applied agricultural fields are deposited such as ponds, lakes, and the aggradational river/stream beds. Future studies for the identification of hotspots should concentrate in those areas.

It is to be noted that the POPs have been legally banned for agricultural use since 1993 in Nepal. Field interaction with the local farmers also reveals that the DDT and Lindane (BHC) in the agricultural farms were replaced by the other pesticides towards the same period (after 1993). This shows that the enforcement of legal tools for the control of POPs, in the context of Nepal is very effective. It also demonstrates the important role of government regulation in protecting human and the environment from POPs and other chemicals. The residue analysis of 1980, 1994 and the present also conforms the gradual decline of DDT, Lindane (BHC) residues in the vegetable items over the years.

It is true that the POPs use in Nepal has declined over the years. The major reason is the legal restriction. The farmers are not using it, because it is not readily available in the market. The question is whether they will use it or not if it is made available by any source and means. The knowledge of the common Nepali farmers on the POPs pesticide is very limited. Most of them do not even know what POPs are or the harms they can pose to public health and the environment. Future programs on the POPs elimination, hence, should target the awareness level of the common Nepali farmers together with exchange of information on why certain pesticides including POPs have been legally restricted for use in Nepal.

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