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**SCOPE OF NEEM (AZADIRACHTA INDICA) PESTICIDES IN AGRICULTURE – A STUDY IN WEST BENGAL****DR. A. K. NANDI****ASSOCIATE PROFESSOR****DEPARTMENT OF AGRICULTURAL ECONOMICS****BIDHAN CHANDRA KRISHI VISWAVIDYALAYA****MOHANPUR****DR. JAYANTA DUTTA****ASST. PROFESSOR****DEPARTMENT OF AGRICULTURAL ECONOMIC****REGIONAL RESEARCH STATION (OAZ)****UTTAR BANGA KRISHI VISWAVIDYALAYA****MAJHAN****DR. B. K. BERA****ASSOCIATE PROFESSOR****DEPARTMENT OF AGRICULTURAL ECONOMICS****BIDHAN CHANDRA KRISHI VISWAVIDYALAYA****MOHANPUR****DR. A. K. MUKHOPADHYAY****PROFESSOR****DEPARTMENT OF AGRICULTURAL ENTOMOLOGY****BIDHAN CHANDRA KRISHI VISWAVIDYALAYA****MOHANPUR****ABSTRACT**

*Intensive exploitation of synthetic pesticides pollutes the environment by contaminating soil, water, air and food. Since antiquity, neem as a botanical insecticide is used by our predecessors. But with the onslaught of synthetic pesticides during 1940s the use of neem pesticide becomes obsolete. There is an urgent need to switch over from chemicals to botanical pesticides specifically neem. In spite of enactment of Insecticides Act, banned and very highly toxic pesticides (red label) are in vogue in protecting the crops from the ravages of insect pests. Organochlorine and organophosphorus groups of pesticides are found widely used for all crops. Vegetables are found consuming pesticides much higher than other crops. On the contrary, neem as a botanical insecticide proves its excellence from the viewpoint of reducing cost of cultivation, income and employment generation and above all its eco-friendly nature. Phase-wise processing of neem pesticide and cost involvement is highlighted here. The concept of preparing home-made pesticide comes to the fore in this context. Thirty three man-days per hectare are estimated to be created for the preparation of requisite quantum of neem pesticides for spraying pointed gourd followed by chilli (22 man days) and Brinjal (about 17 man days). Serious efforts are to be taken by public and private agencies to motivate farming community in favour of using neem-based pesticide.*

**KEYWORDS**

Scope of Neem, Employment generation, Neem Pesticide, Neem, Use of Neem Pesticides.

**INTRODUCTION**

**W**ith the explosion in population within few decades the country will be facing severe problem to meet the overwhelming domestic demand for food in the forthcoming future. Land, a major factor of production, is limited and cannot be expanded further. In order to keep pace with the growing demand for food a substantial hike in the productivity of land through sustainable use of natural resources is of prime importance today. At the same time adoption of low cost cultivation techniques through exploiting natural resources with a view to safeguard public health becomes very pertinent. Excessive and indiscriminate exploitation of chemical pesticides not only endangers human civilization but also pollutes the environment to a great extent and has given rise to genetic resistance of pest species. Merely, 1 percent of the pesticides applied to a crop reach the target pests and the remaining 99 percent contaminates soil, water, air, food etc<sup>1</sup>. In view of preventing imminent danger for human being, other creatures and restoring environmental balance, attention must be given towards judicious and need based pesticide use or using biodegradable and environment friendly botanical pesticides to maintain the sustainability. Pesticide derived from neem comes under the purview of botanical pesticides and it is envisaged that these products will substitute the synthetic plant protection materials quite satisfactorily.

<sup>1</sup> Dhaliwal, G. S. and Arora, R. Integrated Pest Management - concepts and approaches, P. 282

Neem (*Azadirachta indica*), an evergreen perennial crop is used widely by our ancestors since time immemorial. It belongs to the family Meliaceae and is indigenous to India. The repellent and antifeedent effects of neem have been reported against a wide range of insect pests. All parts of the tree possess insecticidal activity but seed kernel is the most active. Nearly hundreds of chemicals have been extracted from various parts of neem tree and Azadirachtin, the most important biologically active component exhibits phagorepellent and toxic effects to various insect pests<sup>2</sup>.

Commercialization of neem-based pesticide is expanding very fast. Nearly hundreds of products are either being marketed or are awaiting commercialization in India. Preparation of neem-based pesticides by local production units comes to the fore<sup>3</sup> keeping in view the resource poor small and marginal farmers.

## OBJECTIVES

The major objectives of the study are as follows:

- to study the present status of pesticide uses in West Bengal
- to observe the degree of uses of different labels of synthetic pesticides in sample area
- to point out the magnitude of application of different groups of pesticides in different crops
- to calculate the cost of preparation of neem pesticides, and
- to observe the employment potentiality generated from the preparation of neem pesticides.

## METHODOLOGY

The present study attempts to evaluate the economics of using neem pesticide in crop production. A survey was conducted in 2001-02 among 430 farm households spread over five agricultural districts namely, Bardhaman, Hooghly, Nadia, South 24-Parganas and Murshidabad of West Bengal following three-stage random sampling to examine the extent of use of various types of traditional pesticides *vis-à-vis* neem pesticide in agriculture. The costs have been inflated at 12.50 per cent per annum to reach the expected costs for the year of 2011-12.

## RESULTS & DISCUSSIONS

### A. PRESENT STATUS OF PESTICIDE USE

At the outset, consumption of pesticides in terms of physical volume as well as active ingredient form in West Bengal over time is presented here. A slightly upward trend in the consumption of pesticides is visualized from 1991 to 1994 whereas from 1994 onwards a declining trend is noteworthy. This diminishing trend in the use of quantity of pesticides may be due to efficient implementation of IPM, use of biological control techniques and uses of modern pesticides. The further investigation may be done to churn out the probable causes of declining trend of pesticide uses. The graphical presentation of the data-set presented in Table-1 visualizes clearly from Fig-1.

TABLE-1: CONSUMPTION OF PESTICIDES IN WEST BENGAL

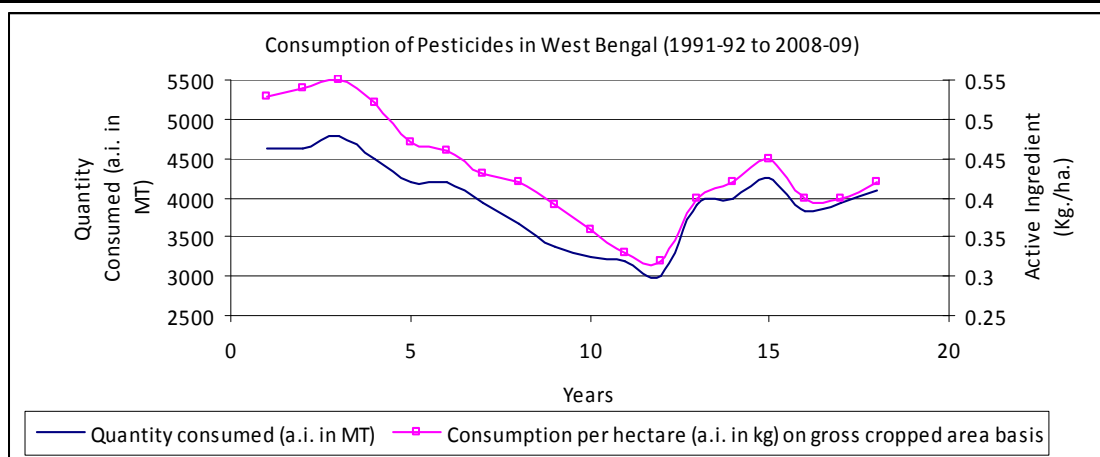
Year	Quantity consumed (a.i. in MT)	Consumption per hectare (a.i. in kg) on gross cropped area basis
1991-92	4612	0.53
1992-93	4625	0.54
1993-94	4790	0.55
1994-95	4500	0.52
1995-96	4210	0.47
1996-97	4196	0.46
1997-98	3930	0.43
1998-99	3678	0.42
1999-2000	3370	0.39
2000-01	3250	0.36
2001-02	3180	0.33
2002-03	3000	0.32
2003-04	3900	0.40
2004-05	4000	0.42
2005-06	4250	0.45
2006-07	3830	0.40
2007-08	3945	0.40
2008-09	4100	0.42

**Source:** Directorate of Agriculture, Plant Protection and Quality Control, Govt. of West Bengal, India.

<sup>2</sup> Saxena, R. C. Scope of neem for developing countries, Souvenir World Neem Conference, Feb. 24-28, 1993, Bangalore, India, pp. 30-36

<sup>3</sup> Lim, G. S. and Bottrell, D. G. (1994) Neem pesticides in rice: potential and limitations, International Rice Research Institute, Manila, Philippines





The study uses the concept of Intensity of using of a particular label of pesticide for a particular crop to observe the degree of uses of different labels. The following formula has been used to work out the intensity of pesticide uses.

Intensity of using a particular label of pesticide for a particular crop

$$= \frac{\text{No. of application of a particular label of pesticide for a particular crop of total surveyed farmers}}{\text{No. of farmers cultivating that particular crop}} \times 100$$

**TABLE-2: INTENSITY OF DIFFERENT LABELS OF PESTICIDES USED BY THE HOUSEHOLDS DURING 2001-02**

Vegetables	Banned	Red Label	Yellow Label	Blue Label	Green Label
Chilli	5.55	100.00	116.67	33.33	11.11
Bhindi	0.00	107.14	57.14	57.14	0.00
Brinjal	0.00	104.35	65.22	69.56	4.35
Cabbage	12.50	37.50	41.67	8.33	145.83
Potato	1.92	50.00	50.00	7.69	80.77
Tomato	6.67	13.33	113.33	0.00	13.33

According to the degree of toxicity, pesticides are generally classified into varying labels e.g. red, yellow, blue and green labels defined as very high toxic, highly toxic, moderately toxic and slightly toxic pesticides respectively. Intensity of using different labels of pesticides for some important vegetables by the farm households is highlighted in Table-2. Red label pesticides are found to be widely used in case of bhindi and brinjal whereas pesticides belonging to yellow label are reported to be used massively in case of chilli and tomato. Slightly toxic pesticides are used mostly in case of cabbage. The study also points out the uses banned pesticides in an insignificant proposition.

**TABLE-3: APPLICATION OF VARIOUS CHEMICAL GROUPS OF PESTICIDES AND THEIR ACTIVE INGREDIENTS (KG / HA) IN DIFFERENT CROPS IN THE SELECTED CROPS OF WEST BENGAL**

Crop	Organo-chlorine	Organo-phosphorus	Carbamate	Benzi-midazole	Dithio-carbamate	Synthetic Pyrethroid	Azadirachtin	Organophosphorus +synthetic Pyrethroid	Total
Winter Paddy	0.66 (68.25)	0.19 (19.65)	0.10 (10.34)	0.004 (0.42)	0.01 (1.03)	0.002 (0.21)	0.001 (0.10)	-	0.967 (100.00)
Summer Paddy	0.45 (64.01)	0.12 (17.07)	0.12 (17.07)	0.001 (0.14)	0.01 (1.43)	0.001 (0.14)	0.001 (0.14)	-	0.703 (100.00)
Jute	0.47 (73.44)	0.13 (20.31)	0.04 (6.25)	-	-	-	-	-	0.64 (100.00)
Wheat	0.06 (6.79)	0.004 (0.45)	0.23 (26.02)	0.57 (64.48)	0.02 (2.26)	-	-	-	0.884 (100.00)
Mustard	0.05 (31.25)	0.11 (68.75)	-	-	-	-	-	-	0.16 (100.00)
Brinjal	0.23 (4.51)	0.72 (14.12)	3.83 (75.10)	-	0.08 (1.57)	0.24 (4.70)	-	-	5.10 (100.00)
Bhindi	0.32 (3.66)	2.67 (30.51)	-	-	-	0.29 (3.31)	-	5.47 (62.52)	8.75 (100.00)
Pointed gourd	9.56 (29.68)	0.41 (1.27)	0.30 (0.93)	2.20 (6.83)	19.74 (61.29)	-	-	-	32.21 (100.00)
Chilli	1.27 (38.25)	1.77 (53.31)	0.08 (2.41)	0.06 (1.81)	0.05 (1.51)	0.09 (2.71)	-	-	3.32 (100.00)
Tomato	0.67 (62.04)	0.15 (13.88)	0.03 (2.78)	0.10 (9.26)	0.10 (9.26)	0.03 (2.78)	-	-	1.08 (100.00)
Potato	0.77 (21.21)	0.12 (3.31)	0.21 (5.79)	0.16 (4.41)	2.37 (65.28)	-	0.00003 (0.001)	-	3.63003 (100.00)

Note: Figures within parenthesis indicate percentage of the respective total.

Pesticide use behaviour in different crops is presented in Table-3 based on various chemical groups along with the actual application of active ingredients. Pesticides are consumed heavily by the vegetables as compared to other crops. Organochlorine and organophosphorus groups of pesticides are reported to be used for all the crops surveyed. Highest utilization of the former group of pesticides is observed in case of jute (73.44 percent) followed by winter paddy,

summer paddy and tomato. Efficacy of this group of pesticides is well-known for controlling mites in jute, Brown Plant Hopper (BPH), Green Leaf Hopper (GLH), yellow stem borer of rice and fruit borer in tomato.

Organophosphorus group of pesticides is reported to be used massively in case of mustard (about 69 percent) to check the aphid infestation. Carbamate group of pesticides is visualized excessively used for Brinjal (75 percent) to fight out against the fruit and shoot borer. Redundant use of benzimidazole group of pesticides is observed for wheat (64 percent) to prevent the fungal diseases. Dithiocarbamate group of pesticides are very effective against late blight disease of potato and nematode infestation in case of pointed gourd as reflected by its use. Consumption of neem based pesticides containing Azadirachtin is noticed in case of summer paddy, winter paddy and potato, though in a very small quantum.

#### B. COST OF PREPARATION AND APPLICATION OF NEEM SEED KERNEL EXTRACT

Costs incurred for various components and for performing some operations in the preparation of exact amount of neem pesticide from neem seed for selected vegetables are furnished in Table-4. Treatment with neem pesticide containing various quantities of neem seed kernel for different vegetables is approximate. In-depth study is required to determine the accurate dose of neem pesticide to be applied for various crops. Considering the duration of crop and thereby the number of sprays needed for each crop at an interval of 10 days, the total expenditure for processing of neem pesticide is worked out though it is imputed.

**TABLE-4: ESTIMATED COST FOR PREPARATION OF NEEM PESTICIDE FROM NEEM SEED FOR SPRAYING PER HECTARE OF DIFFERENT VEGETABLES DURING 2011-12**

Crop	Duration (months)	Quantity of neem kernel used (gm)	No. of sprays needed	Cost of neem seeds(Rs.)	Cost of labour (Rs.)	Cost of gunny bags (Rs.)	Cost of adjuvant (Rs.)	Total cost (Rs.)
Brinjal	6	25	18	5468	1849	547	501	8364
Chilli	4	50	12	7290	2465	729	668	11152
Bhindi	3	25	9	2734	924	273	251	4182
Tomato	3	25	9	2734	924	273	251	4182
Cabbage	3	25	9	2734	924	273	251	4182
Cauli-flower	3	10	9	1094	370	109	100	1673
Pointed gourd	6	50	18	10935	3697	1094	1002	16728

\*\* considering statutory wage rate (Rs. 110/ man-day); Costs deflated at 2011-12 prices

\*\*\* Based on moderate infestation of pests.

A comparison between costs on chemical pesticides vs. neem is visualized from Table-5. From the point of view minimization of cost in crop production, neem pesticide as a plant protection material exhibits its excellence over chemicals in most cases. Negative differences are observed in case of tomato and chilli may be attributed to use of over exploitation of chemicals as general farmers believe that higher doses of pesticides yield more crop production.

**TABLE -5: CROP WISE COMPARISON OF CHEMICAL PESTICIDE COST AND NEEM BASED PESTICIDE COST PER HECTARE DURING 2011-12**

Crop	Chemical pesticide*	Neem kernel**	Difference
Tomato	3580	4182	-602
Chilli	9225	11152	-1927
Cabbage	10903	4182	6721
Bhindi	21772	4182	17590
Brinjal	32993	8364	24628
Pointed gourd	43091	16728	26362

\* Calculated on the basis of Prime Cost (Cost D) concept of farm

\*\* Estimated on the basis of field level experiment at Central Research Farm, Gayeshpur, B. C. K.V. due to lack of present use at farmers' level.

#### C. EMPLOYMENT POTENTIALITY

Besides value addition, there is an ample scope for generation of income and employment in the rural sector from the processing of neem pesticide<sup>4</sup> as depicted from Table-6. The computation is made on the basis of duration of the crops, doses applied to the crops and prevailing wage rate (Rs. 110 per man-day) for all operations. The highest man-days (33 man-days) are estimated to be created for the preparation of requisite quantum of neem pesticide for spraying pointed gourd followed by chilli (22 man-days) and brinjal (16.67 man days). So there is an immense opportunity for unemployed rural masses to be engaged in the collection of neem fruits and manufacture of neem pesticide indigenously for their subsistence. Singh (2002)<sup>5</sup> in his study also expressed similar opinion regarding the creation of huge employment opportunities to rural and tribal population through harnessing the potential of neem. In addition to that, the farming community has to lay more emphasis on the preparation of homemade neem pesticide exploiting the family labour including female labour with a view to reduce the cost of cultivation.

**TABLE-6: ESTIMATION OF MAN-DAYS FOR PROCESSING OF NEEM PESTICIDE FROM NEEM SEED PER HECTARE FOR DIFFERENT VEGETABLES**

Crop	Operation wise requirement of man-days							
	Cleaning and grading	De-pulping	Warming	Drying	Storing	Pulverisation	Packaging	Total
Brinjal	1.96	1.76	2.16	2.16	2.16	5.03	1.44	16.67
Chilli	2.61	2.35	2.87	2.87	2.87	6.71	1.92	22.21
Bhindi	0.98	0.88	1.08	1.08	1.08	2.52	0.72	8.33
Tomato	0.98	0.88	1.08	1.08	1.08	2.52	0.72	8.33
Cabbage	0.98	0.88	1.08	1.08	1.08	2.52	0.72	8.33
Cauliflower	0.39	0.35	0.43	0.43	0.43	1.01	0.29	3.33
Pointed gourd	3.92	3.53	4.31	4.31	4.31	10.06	2.87	33.31

<sup>4</sup> Mruthyunjaya and Jha, D. Economics and policy issues, Neem, Society of pesticide science, 1993, pp. 311-317

<sup>5</sup> Singh, S. R. Role of small scale Industries in harnessing the true potential of neem products, Proceedings of World Neem Conference, 2002, p. 10

**CONCLUSION**

Neem as a botanical insecticide is used since antiquity to protect agricultural crops from the ravages of insect pests. However, the efficacy, simplicity and flexibility of broad spectrum synthetic pesticides evolved during 1940s made the use of botanical pesticides obsolete. Exclusive reliance and dependence on synthetic insecticides for managing all insect pests have created a number of ecological problems and aggravation of pest attack on crops. In realizing the adverse effects of synthetic chemicals neem has attracted the attention of the scientific community. Taking into account the economic aspects as well as environmental aspects of using neem insecticide the need of the hour is to motivate and direct the farming community in favour of using the same in lieu of synthetic ones wherever possible and for that to promote neem plantation on the uncultivable marginal lands leading to wasteland development and thereby boosting agricultural economy to some extent. The study also points out the low cost involvement in use of neem pesticides than chemical pesticides in most of vegetable crops except tomato and chilli. Generation of man days could be possible through the preparation of neem pesticides and application of it. Preparation of neem pesticides can generate 33 man-days of employment per hectare in case of pointed gourd followed by chilli and brinjal. Self Help Groups (SHG) comprising particularly the village women are to be engaged for preparation of neem pesticides to provide them an alternative engagement of job.

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