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Excessive use of fertilizers and plant protection chemicals in paddy and its economic impact in Tungabhadra Project Command area of Karnataka, India

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ABSTRACT

Nitrogenous fertilizers and plant protection chemicals have been universally accepted as an integral part of package of practice for raising Indian agriculture to higher technological plank. The excessive use of nitrogenous fertilizers has resulted in higher plant protection chemicals and has further resulted in heavy economic loss. In order to examine different dimensions of economic aspects of selected inputs, a study was carried out in Tungabhadra Project (TBP) area of Karnataka during the year 2011-12 for which multistage random sampling design was employed for a sample size of 90 farmers. The study revealed that the extent of application of insecticides increased from 5413 mL/g a.i/ha to 7338 mL/g a.i/ha, fungicides application from 805 mL/g a.i/ha to 1283 mL/g a.i/ha and weedicides from 4853mL/g a.i/ha to 7625 mL/g a.i/ha from level 1 (upto 50% recommended dose of nitrogen) to level 3(>100% recommended dose of nitrogen), respectively. Further, per acre excessive use of nitrogenous fertilizers and plant protection chemicals ranged from 24.61kg to 79.08 kg and 1321.37 mL/g active ingredient to 2687.65 mL/g respectively from level 1 to level 3, respectively in paddy cultivation. The estimated economic loss due to excess use of nitrogenous and plant protection chemicals for the TBP area as a whole was Rs. 8618.4 lakhs. Majority of farmers were unaware of recommended dose, quantity of application and illeffects of these inputs. Thus, emphasis must be given for adoption of Integrated Pest Management (IPM) and Integrated Nutrient Management (INM) and needs promotion through different extension strategies to minimize the losses.

Key words : *Paddy, Nitrogen, Plant protection chemicals, Command area*

Introduction

Rice is a popular staple food for nearly half of the world's population, most of them living in Asia. India is facing challenges to feed its growing population. It is estimated that about 260 million tonnes (MT) of food grains is to be produced annually by 2030 to meet the food requirement. The modern technology introduced in mid-sixties led to "Green Revolution". The five important components of agricultural technology namely: 1) hybrid and HYV seeds, 2) Inorganic fertilizers, 3) Plant protection chemicals, 4) Irrigation and 5) Mechanization, when used individually or together enhance the returns

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from production either by shifting the production curve upward or by reducing cost per unit of output. The new technology in agriculture is envisaged to transform traditional agriculture to modern one.

Paddy (*Oryza sativa* L.) is one of the important cereal crops of India with largest area in the world (39.2 million ha) with a total production of 104.4 million tonnes during 2012 and it stood next only to China in the world with respect to production. In India, Karnataka is one among the paddy growing states and is grown in an area of 14.16 lakh ha with an annual production of 41.88 lakh tonnes during 2012 (Anon., 2012). Further, paddy is one of the most important cereal crops grown in the Tungabhadra Project (TBP) Command area of Karnataka which covers 3.6 lakh hectare in *kharif* and 2.52 lakh hectare in *rabi*/summer. It is proved that nitrogenous fertilizers are the most important input contributing for the improvement of paddy yields since long. Though farmers are advised by the agricultural extension workers to use recommended dose of nitrogenous fertilizers still farmers are using these fertilizers indiscriminately. The excessive use of nitrogenous fertilizers has resulted in higher plant protection chemicals and has further resulted in increase in pest resistance, pest resurgence, secondary pest and also high cost structure in the production process.

TBP area is most backward region of Karnataka with respect to education, social and economic status, market roads etc. Paddy is the major crop grown which contribute major share in livelihood of this region. Farmers of this region are not aware of package of practices and are using high value inputs indiscriminately.

Therefore an attempt is made in the present study to analyse the extent and economic loss due to overuse of high value inputs like nitrogenous fertilizers and plant protection chemicals in paddy in TBP area of Karnataka. The specific objectives of the study are to know the frequency of different plant protection practices and to analyze the economic loss of plant protection and nutrients in paddy cultivation under selected nutrient management scenario.

Materials and Methods

The study was confined to Tungabhadra Project (TBP) area of Karnataka state. The Tungabhadra project area consists of three districts viz., Raichur, Koppal and Bellary. To get a representative sample, multistage random sampling design was used. In the first stage, three talukas were selected from each district based on the highest area under paddy namely Sindhanur (Raichur district), Gangavathi (Koppal district) and Siruguppa (Bellary district). In the second stage, three villages from each choosen taluka were selected randomly. In the third stage, ten farmers from each of the selected villages were choosen at random. Thus, the total sample size comprised of 90 farmers. The primary data was collected from sample farmers using pre-tested questionnaire prepared for the purpose. The primary data on education, social background, family size, frequency of spray, quantity of spray, number of chemicals sprayed, etc were collected from sample farmers. The aforesaid information pertained to the kharif and rabi/summer seasons of agricultural year 2011-12. The post classification of farmers were followed based on the extent of nitrogen used in relation to recommended level in paddy cultivation in TBP area was as given below:

The secondary data on area under paddy crop, prevailing market price, land holding etc were collected from district statistical office of respective district.

Level-1: Sample farmers using upto 50% higher than the recommended dose of nitrogen.

Level-2: Sample farmers using more than 50% and upto 100% of recommended dose of nitrogen.

Level-3: Sample farmers using more than 100% of recommended dose of nitrogen.

Controlled/Recommended dose of nitrogen application: 150 Kg/ha (Anon., 2011).

Results and Discussion

The average frequency of application insecticides and combination of insecticides and fungicides (Table 1) was increasing with increase in nitrogen from level 1 to 3. In case of weedicides and liquid/powder form was not statistically significant. The tendency of increase in the application of insecticides and fungicides under different nitrogen level scenario clearly indicated that the application of more and more of nitrogenous chemical fertilizers in paddy resulted in more and more application of insecticides and fungicides. However, the pattern of application of weedicides was not closely associated with extent of use of nitrogen in paddy cultivation. It was worthnoting that majority of the farmers applied insecticides and fungicides combinely which

increased from three applications in nitrogen level 1 to five applications in nitrogen level 3 (Table 1) under paddy cultivation in Tungabhadra project command area.

The pattern and extent of plant protection chemicals clearly in Table 2 indicated that the extent of application of plant protection chemicals and their management considerably increased with increase in the nitrogen use in paddy cultivation under Tungabhadra project command area. The application of more and more nitrogen to paddy might have resulted in vigorous, fleshy, greenly vegetative growth due to which plants became succulent leading to increase in incidence of pests and diseases. Thus, the farmers who had applied higher than the recommended dose (150:75:75 kg/ha) of fertilizers did used higher levels of pesticides leading to increase in cost of cultivation.

The pattern of use of both insecticides and fungicides were found to be similar. It is clear from Table 2 and Fig. 1 that majority of farmers were applying more than 50 per cent of the recommended dose of insecticides and fungicides in case of level-3 compared to level-1. The cost incurred on different forms of chemicals revealed that in all the cases farmers spent more cost on insecticide, followed by weedicides and fungicides. However, level-3 farmers have spent more money on all the chemicals

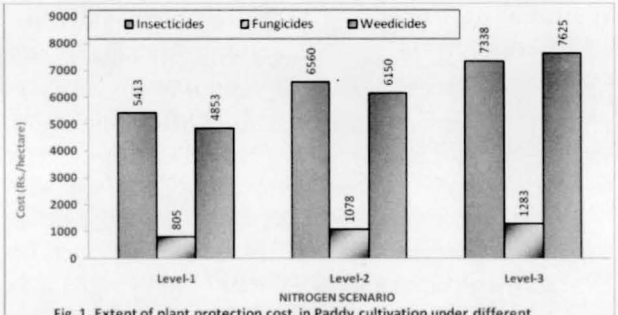

Fig. 1. Extent of plant protection cost in Paddy cultivation under different nitrogen scenario

Table 1. Frequency and nature of application of pesticides in paddy under different scenario

Sl. No.	Particulars	Numbers		
		Level-1	Level-2	Level-3
1.	Number of application of insecticides	2.00	3.00	4.00
2.	Number of application of fungicides	1.00	2.00	3.00
3.	Number of application of weedicides	1.00	1.00	1.00
4.	Combination of insecticides + fungicides	3.00	4.00	5.00
5.	Number of application of granular insecticides	1.00	1.00	1.00

Table 2. Extent of plant protection used in paddy under different scenario

Sl. No.	Plant protection chemicals	Unit	(Active ingredient/ha) Level-1	Level-2	Level-3
1	Insecticides				
	a) Liquid form	ml	2538	3135	3563
	b) Granular form	gm	2875	3425	3775
	Sub total	*ml/gm*	*5413*	*6560 (21.18)*	*7338(35.56)*
2	Fungicides				
	a) Liquid form	ml	75	115	145
	b) Powder form	gm	730	963	1138
	Sub total	*ml/gm*	*805*	*1078 (33.91)*	*1283(59.37)*
3	Weedicides				
	a) Liquid form	ml	2103	2275	2675
	b) Powder form	gm	2750	3875	4950
	Sub total	*ml/gm*	*4853*	*6150(26.72)*	*7625(57.11)*
4	Total				
	a) Liquid form	ml	4716	5525	6383
	b) Powder form	gm	3480	4838	6088
	c) Granular form	gm	2875	3425	3775
	d) overall	ml/gm	11071	13788	16246

Figures in parenthesis indicate percentage change over level-1

used for paddy production than the level-2 and level-1. Therefore, there is an urgent need for providing proper awareness and education to TBP farmers about excessive use of nitrogen and pesticide and their implications on income and cost etc. Santa Kumar and Dhandapani (2000) and Nyugen and Tran Thi (2003) reported similar findings in cotton and paddy cultivation. Further, it was observed that the frequency of application of plant protection chemicals were increasing with increase in nitrogen levels (Table 1). This could be one of the reasons that brown plant hopper and stem borer emerged as serious insect pests in TBP area and sheath blight, leaf reddening and rice blast as a serious diseases. This resulted in pests to develop resistance against existing pesticides and emerged as resurgence pests. Such an over dosage of chemicals might have caused the destruction of many of the beneficial insects which leads to the emergence of more virulent pests. Thus there was over use of resources especially nitrogen and plant protection chemicals in paddy production and therefore the extension agencies have to popularize the Integrated Pest Management (IPM) and Integrated Nutrient Management (INM) practices among the farmers of paddy cultivation and further emphasis needs to be given on practicing organic farming, use of biofertilizers and bioagents in paddy production to minimise the usage of plant protection chemicals.

It is evident that farmers in TBP area were applying more and more of nitrogenous fertilizers which has resulted in increased use of plant protection chemicals. Though the cost incurred towards nitrogen and plant protection chemicals was very high but there was no much difference in returns. This clearly points out that farmers were unnecessarily and indiscriminately applying nitrogen and plant protection chemicals which might have resulted in more economic loss. The economic loss for the whole TBP area was also estimated at Rs. 8618.4 lakhs every year. Thus, the farmers could have saved this much quantity of nitrogen and plant protection chemicals if they were using optimum quantity of nitrogen and plant protection chemicals. If the same trend continues, then the farmers would reach a more critical stage wherein the soil loses its potentiality for production. Similar findings were found in Kishori (1994); Dhaliwal, and Arora, (1996); Dhaliwal (1993); David Pimentel (2005) and Thakur and Hossain, (2008). Thus, farmers in Tungabhadra project command area might be given a warning bell about excessive use of nitrogen and plant protection chemicals. A proper training may be provided for the adoption of integrated pest management (IPM) and integrated nutrient management (INM).

In terms of quantitative terms, nitrogen loss ranged from 61.522 to 197.70 kg/ha and plant protection chemicals from 3302 to 6720 mL/g a.i/ha amounting to monetary loss from Rs. 402.50 to 1297.50 per/ha and Rs. 1452.50 to Rs. 2957.50 per/ha from level-1 to leve-3 respectively, .which accounts to 63 percent nitrogen loss in quantitative and monetary terms in level-2 and 222 percent in level-3 (Table 3).

It is evident that overall monetary loss due to use of both nitrogen and plant protection chemicals more than their optimum level was estimated at Rs. 8,618.4 lakhs every year (Table 4 and Fig. 2). However, the extent of monetary loss was contributed mainly (67.11%) from loss in plant protection chemi-

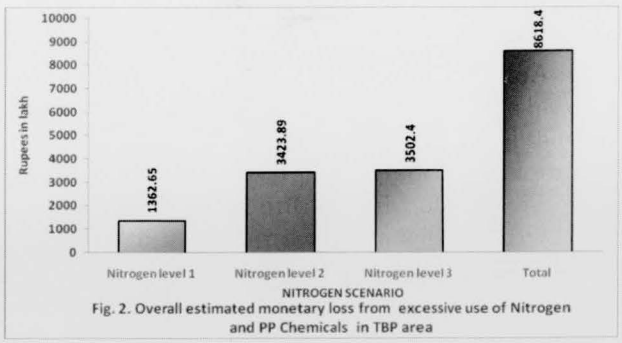

Fig. 2. Overall estimated monetary loss from excessive use of Nitrogen and PP Chemicals in TBP area

Table 3. Economic loss from excess use of high value inputs in paddy under different scenario (Per ha)

Sl. No.	Particulars	Excess use of nitrogen		Excess use of PPC	
		Quantity	Monetary	Quantity (ml/g a.i)	Monetary (Rs.)
1.	Level-1	61.52	402.50	3302	1452.50
2.	Level-2	100.30(63.00)	657.50	4810(45.64)	2117.50
3.	Level-3	197.70(222)	1297.50	6720(103.40)	2957.50
4.	Overall	299.55	1968.75	12375	5737.50

Note: Figures in parenthesis indicate percentage change over level-1

Table 4. Estimated monetary loss through excessive use of high value inputs in TBP command area of Karnataka

Sl. No.	Particulars	Level-1	Level-2	Level-3	Overall
1.	*% area under different scenario*	26.67	44.45	28.89	100
2.	*Total area under paddy*				
	a) *Kharif* (lakh acre)	2.40	4.00	2.60	9.00
	b) *Rabi*/summer(lakh acre)	1.68	2.80	1.82	6.30
3.	Relative monetary loss (Rs./acre)				
	a) Nitrogen	161	263	519	315
	b) Plant protection chemicals	581	847	1183	918
4.	Total monetary loss in TBP area (lakh Rs.)				
	a) Nitrogen	386.44(28.35)	1052.00(30.72)	1349.4(38.52)	2835(32.89)
	b) Plant protection chemicals	976.08(39.59)	2371.89(69.27)	2153.02(61.47)	5783.4(67.11)
	c) Total	1362.65(100.00)	3423.89(100.00)	3502.4(100.00)	8618.4(100.00)

cals (Rs. 5,783.4 lakhs) followed by loss from nitrogen (Rs. 2,835 lakhs). Similar trend of loss in both nitrogen and plant protection chemicals was observed under different nitrogen level scenarios.

It was worth noting that most of the farmers applied plant protection chemicals along the wind direction which reduced farmers exposure to chemicals. This is the correct method of applying plant protection chemicals and has reduced the probability of poisonous effects through inhalation of chemicals. However, most of the applicators did not use any protective coverings like hand gloves, shoes and face masks. This increased the probability of exposure to poisoning by contact and health hazards. Regarding mixing of pesticides with water, it was observed that 8.80 per cent of farmers were using wooden stick thinking that by use of stick proper mixing of chemical is possible. Some farmers used bare hands for mixing chemical which is a wrong practice because it leads to severe health hazards as pesticides have direct impact on contact with skin. Similar findings were also reported by Mahantesh (2002) and Arunkumar (1995).

Based on the above findings it is suggested that farmers should be trained about adoption of Integrated nutrient management (INM) and integrated pest management (IPM) practices in paddy cultivation in TBP area. Also, proper training has to be provided about use of protective coverings to overcome the health hazards associated with pesticide use on human health and environment.

Conclusion

It is concluded that the extent of application of insecticides increased from 54,13 mL/g active ingredient/ha to 73,38 mL/g active ingredient/ha, fungicides application from 805 mL/g active ingredient/ha to 1283mL/g active ingredient/ha and weedicides from 4853 mL/g active ingredient/ha to 7625 mL/g active ingredient/ha from nitrogen level 1 (upto 50% RD of nitrogen) to nitrogen level 3(>100% RD of nitrogen), respectively. Thus, economic loss from excessive use of nitrogenous fertilizers and plant protection chemicals ranged from Rs. 24.61kg/acre to 79.08 kg/acre and 1321.37 mL/g a.i/acre to 2687.65 mL/g respectively from nitrogen level 1 to 3, respectively in paddy cultivation and the estimated monetary loss more than the optimum level of nitrogenous and plant protection chemicals for the TBP area as a whole was Rs. 8618.4 lakhs. The excessive use of nitrogenous fertilizers and plant protection chemicals has not only resulted in high cost structure but also in turn has affected the soil health and in build resistance of pest which clearly indicates lack of knowledge about use of high value inputs indiscriminately. Thus, emphasis must be given for adoption of Integrated Pest Management (IPM), Integrated Nutrient Management (INM), organic farming and use of biocontrol agents and needs promotion through different extension strategies about use of these critical inputs to minimize the losses.

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