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Monetary valuation of deterioration in soil health in terms of the excess/deficit of the macro and micro nutrients available in the soil

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Abstract

Total cost for the degradation/depletion of macro-nutrients amounted to Rs. 39432.44 per hectare in Sri Ganganagar and Rs.16010.37per hectare in jaipur. The cost in terms of degradation/depletion of micro-nutrients amounted to Rs. 17770 per hectare in Sri Ganganagar and Rs.23854 in Jaipur. The environmental cost for the high value cash crop was estimated to Rs. 57202.44 in Sri Ganganagar and Rs. 39864.37 in Jaipur.

Keywords: Macro and micronutrient,soil health,soil deterioration, human health and environmental cost

Introduction

Agrochemicals used to increase agricultural productivity, have also been associated with many direct and indirect negative impacts on human health. These effects are increasingly manifested in loss of working efficiency resulting in higher cost of production. In recent times, the effects of commercialization of agriculture on environment and human health have attracted the attention of both the scholars and policy makers (Pingali *et al*, 2001 ^[8], Pingali and Rosegrant, 1995) ^[7].

The severity and risks of adverse impacts are higher in developing countries where users are quite often illiterate, ill-trained, and do not possess appropriate protective equipments. It is estimated that only 0.1 per cent of applied pesticides reach the target pests, leaving the bulk of pesticides (99.9 percent) to impact the environment and human health (Pimental, 1995). The emphasis on organic agriculture is the direct outcome of the increasing awareness of the adverse effects of the excessive use of agro-chemicals. The present study is a modest attempt in this direction. Against this background, the present study aims at documenting the high value cash crops cultivation led adverse changes in the natural resource base, the strategies adopted by the local people to minimize the adverse impacts, monetary valuation of environmental costs, understand their implications for the livelihoods of the local people and suggest possible solutions. Such a study is essential in estimating the true cost of the cultivation of these crops. Keeping this in view, the study has been undertaken with the following objectives:

Objectives

1. Status and requirement of macronutrients and micronutrients in the study area.
2. Monetary valuation of deterioration in soil health.
3. Monetary valuation of total environmental costs.

Materials and Methods**Selection of study area**

Out of 33 districts of the state of Rajasthan, two districts namely Sri Ganganagar and Jaipur were purposively selected for the study. The selection of the districts was influenced by two factors. First, in these districts the cultivation of high value crops namely kinnow and off-seasonal vegetable is being practiced since the late sixties and early seventies. Second, these two districts together account for more than three-fourths of the total area under fruits and vegetables

Collection and preparation of soil samples

The soil samples were separately collected from the cultivated area of each of the 200 sample households. Since kinnow was the most important crop in Sri Ganganagar and vegetables in Jaipur, the soil samples were collected from kinnow orchards in Sri Ganganagar and vegetable fields in Jaipur. The representative soil samples were collected from 0-15 cm depth and tested under laboratory conditions. The samples were analyzed for soil PH (Jackson, 1973) ^[1], Organic carbon (Walkley and Black, 1934) ^[9], available P (Olsen *et al.*, 1954) ^[5], available K (Mervin and Peech, 1950) ^[3] and micro nutrient cations (Cu, Fe, Mn and Zn by Lindsay and Norvell, 1978) ^[2].

The following formula was used to classify the soils into different status:

$$\text{Overall Status of soil} = (I*1 + M*2 + H*3) / 100$$

The values used to classify the soils into low, medium and high through soil nutrient index are given below.

Low < 1.67, Medium 1.67 to 2.33 and high > 2.33 (Muhr *et al.* 1963).

The status of the availability of micro nutrients was considered sufficient if the availability was more than the following critical limits in mg per kilogram. If availability was less than these limits, the status was considered as deficient (Nayyar, and Chhibba, 1995) ^[4].

Zinc = 0.60

Copper = 0.20

Iron = 4.50

Manganese = 1.00

Valuation of environmental cost

Environmental cost has been defined to include the cost of the effect on human health and soil degradation. The effect on human health is estimated to include the number of days lost, the loss in the work efficiency for those who experienced some health problems but did not take medicines, the yearly medical expenditure of the person who handled the pesticides and the value of kit. For computing monetary value of the degradation of soil health, the soil status was compared with the recommended doses in the packages of practices of horticulture and vegetable crops. If the status of a particular nutrient in the soil was high, then recommended dose, given in the package of practices, was reduced by 25 per cent. In case of medium status, the recommend was the same as given in the package of practices. If the status of a particular nutrient was low, 25 per cent was added to the recommended dose. These doses were now considered as optimum doses for a particular nutrient. Thereafter, actual dose used by the farmer was compared with the recommended dose. The difference for different nutrients from their recommended doses could either be excess or deficit. The excess or deficit amount then was converted into monetary value by multiplying the price of a particular nutrient with the excess or deficit amount. The total environmental cost then was apportioned among different crops in proportion to the area under these crops. As mentioned above, all the soil samples in Jaipur were collected from the area under vegetable crops. Therefore, the environmental cost in Jaipur was apportioned only among vegetable crops.

Result and Discussion

Status and requirement of macronutrients and micronutrients in the study area

Table 1.1 shows that among macro nutrients while the status of available nitrogen and phosphorus was high in both the districts, that of potassium was low. Thus, in view of the actual availability of these nutrients in the soils, there recommended doses worked out to be 1340 kg/hectare of nitrogen, 2837.9 kg/hectare of phosphorus and 1120.20 kg/hectare of potassium in Sri Ganganagar.

The respective doses for Jaipur were 230 kg/hectare of nitrogen, 176 kg/hectare of phosphorus and 237.75 kg/hectare of potassium. In comparison, the doses of these three macro nutrients applied by the farmers were 199.86 of nitrogen, 101.02 of phosphorus, 86.36kg/hectare of potassium in Ganganagar and 1320.42 kg/hectare of nitrogen, 637.38 of phosphorus and 280.90 of potassium kg/hectare in Jaipur. In respect of micro nutrients, the results show that except copper, other nutrients like zinc, iron and mn were deficient in Ganganagar whereas in Jaipur soils were found deficient in all the four micro nutrients. The extent of soil degradation was estimated depending on the excess or deficit of macro and micro nutrients.

Table 1.2 shows that in monetary terms, the cost degradation of soil health, both macro and nutrients, amounted to Rs. 44,977 per hectare in Ganganagar and Rs. 2, 98, 556 in Jaipur. In terms of macro and micro nutrients, it was Rs. 32,509 and Rs. 12,468, respectively in Ganganagar and Rs. 10,188 and Rs. 19,668 respectively in Jaipur.

Monitory valuation of deterioration in soil health

Table 1.3 give the total environmental including cost of the adverse effect on human health and degradation of soil. The table shows that these costs together amount to Rs. 57202.44 in Ganganagar and Rs.39864.37 in jaipur. Among these two costs, more than 95 per cent was accounted for by the cost of degradation in soil health in both the areas.

Table 1: Status and requirement of macronutrients and micronutrients in the study area

Primary macronutrients	Sri Ganganagar	Jaipur
Available Nitrogen (kg/ha)	H* (2.90)	H*(2.91)
Dose recommended as per high status (kg/ha)	1340	230
Doses applied by farmers	199.864	1320.42
Nitrogen environment status	-1140.136	1090.42
Available phosphorus (kg/ha)	H* (2.18)	H* (2.58)
Dose recommended as per high status	2837.90	176
Doses applied by farmers	101.02	637.38
phosphorus environment status	-2736.88	561.38
Available potassium (kg/ha)	L* (0.98)	L* (1.02)
Dose recommended as per low status	1120.20	237.75
Doses applied by farmers	86.2536	280.90
Potassium environment status	-1033.95	43.15
Status and requirement of Micronutrients		
Zn	24.59 (D)	60.04 (D)
Requirement (Kg/hac)	36	36
Cu	0	6.36 (D)
Requirement (Kg/hac)	30	30
Fe	38.49 (D)	46.68 (D)
Requirement (Kg/hac)	24	25
Mn	1.08 (D)	23.46(D)
Requirement (Kg/hac)	25	25

Table 2: Monitory valuation of deterioration in soil health (Rs/ha)

Nutrients	Sri Ganganagar	Jaipur
1. Primary Macronutrients		
Available Nitrogen	12543.96	11994.62
Available Phosphorus	17789.72	3648.97
Available potassium	9098.76	366.78
a) Sub total	39432.44	16010.37
2. Micronutrients		
Zn	7920	7920
Cu	-	6084
Fe	3600	3600
Mn	6250	6250
b) sub total	17770	23854
Total (a+b)	57202.44	39864.37

Table 3: Monetary valuation of total environmental costs (Rs/ha.)

Environmental cost	Sri Ganganagar	Jaipur
Cost of the adverse effect on human health	4350	1088
Cost of the degradation of soil health	57202.44	39864.37
Total cost	61552.44	40952.37

Conclusion

High value cash crops has made a significant impact on the economic status of the farmers in terms of their income and employment. It is, therefore, no wonder that policy makers are busy devising strategies to promote agricultural diversification. However, while crop diversification has resulted in higher income and employment to the farmer households, it has also promoted indiscriminate use and unscientific handling of toxic chemicals which is causing degradation of natural resource base and also affecting human health. There is an imposing evidence to indicate that as the process of agricultural diversification towards these crops gets intensified and gains momentum, the extent, severity and frequency of associated health problems are increasing at an alarming rate.

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