NATURAL RESOURCES MANAGEMENT IN NORTH-EAST INDIA

Editors

A. Arunachalam

K. Arunachalam

DVS Publishers

Natural Resources Management in North-East India

(Linking Ecology, Economics & Ethics)

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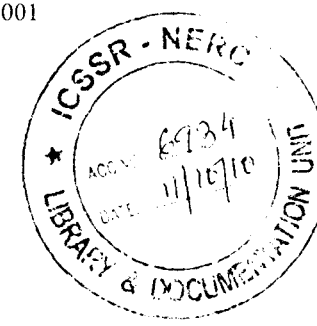

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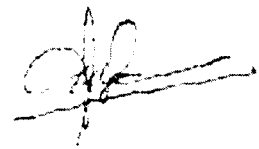
Foreword

The northeastern India is rich in natural resources. The region is globally witnessed for its rich biological diversity. However, over-exploitation of natural resources by the increasing biotic pressure has been a major concern over the years and has resulted in the outbreak of severe environmental problems that are highly complex and multidisciplinary. The destruction of vegetation has resulted in land degradation, soil erosion, landslides, floods/drought and perturbed ecosystems. Thus, it is challenging to the researchers and academicians to link the science behind the management, conservation and restoration of natural resources with the ethics and economics. It is suggested that proper interaction of all the above components are vital to the sustainability of ecosystem health and its functioning. The people of the northeastern also attach traditional values to the nature and its processes. Even this is at is stake owing to modernization. Thus, the linkage between the environment and human development has been in a non-equilibrium state and has impacted upon the natural resources.

This book titled *Natural Resources Management in Northeast India (Linking Ecology, Economics and Ethics)* could fill in the gap in knowledge in the science behind natural resource management in the northeastern India, while addressing the processes of conservation and restoration in an appropriate scale towards achieving the ecological objectives. The book may serve as a guide

to the students and research community besides helping the policy makers in formulating and also in executing new developmental projects in the days ahead keeping in view the natural resources and conservation perspectives.

I wish the editors the very best in their endeavors.



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Preface

Over the past 100 years, the human kind has changed the terrestrial ecosystems more rapidly and extensively than in any comparable period in the history, largely to meet rapidly the growing demands for food, freshwater, timber, fibre and fuel caused by increased population pressure. Although resulted in substantial gains in human well-being and economic development, but the gains have been achieved at growing costs in the form of degradation of many invaluable ecosystems. Hence, natural resources management is a systems' approach and it takes in biological, engineering, social as well as economic components in an integrated system. It includes policy research, provides advices and builds capacity for integrated, participatory and sustainable natural resources management. There have been vigorous discussions among stakeholders about the priorities or the best approach to address the use of natural resources. Topics of discussion revolve around the availability of methods to estimate the environmental impacts of resource use and lay a focus of policy on environmental impacts or on paucity of resources and often call the policy makers to discover the priority areas of research and set targets to measure the progress and ensure the sustainable use and management of natural resources.

The present book *Natural Resources Management in Northeast India (Linking Ecology, Economics and Ethics)* is an upshot of long wannabe desire and a diminutive effort on the part of the editors to bring the academicians, researchers and

policy makers representing various fields of basic and applied science into a common platform. The book is a comprehensive synthesis of 25 significant contributions on different aspects related to the sustainable management of natural resources in the north-eastern India. The book aims at providing adequate background and current information on the various issues relating to the sustainable management of natural resources.

For a good reading, the articles are clustered in to 4 sections viz., (i) Natural Resource Management, (ii) Biodiversity and Ecosystems, (iii) Traditional Farming and its Management and (iv) Conservation and Sustainable Development. This synthesis volume will be quite useful for a large number of individuals-academicians, researchers of this region in particular and also from other parts across the globe, policy makers *etc.* for pursuing future research activities and also for executing the developmental projects in the days ahead.

We are grateful to all the contributors for writing trustworthy and informative articles for this volume. Efforts were made to present their ideas in original shape and while dealing with such a voluminous work, errors may have occurred despite our best efforts. The responsibility of the nominal content however rests on the contributors itself.

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Sustainable Crop Production through Organic Farming

P. Bordoloi, D. Balasubramanian, A. Arunachalam, K. Arunachalam and S.C. Garkoti

Introduction

Green revolution in India is resulted due to intensive agriculture with the extensive use of chemical fertilizers. The intensive agricultural practices boosted the production to feed the growing population. Farmers could harvest three crops in a year with good irrigation facilities. But now is the time for thinking about its adverse effect in the long run on the soil condition in general and on the environment in particular.

Application of organic waste in the crop field increases the crop yield in a desired level. It also increases the physical, chemical and biological properties of soils. Anon (1996), reported that continuous application of farm yard manures at 10 t ha^{-1} was responsible to increase the yield of finger millet by 1447 kg ha^{-1} over absolute control and 152 kg ha^{-1} over continuous application of NPK alone. Many research reports show that crop residues applied to a crop has basified the succeeding crop. Wagger *et al.* (1987) and Ladd *et al.* (1983) have shown that in Wheat-Sorghum and Alfalfa-Wheat systems respectively 12-33 percent and 20-30 percent N mineralized by the crop residue applied to first crop

becomes available for succeeding crop. Similar reports also made for P and K also. Vasanti and Kumaraswamy (1999) also reported increased amount of grain yields, organic carbon contents of available NPK, micronutrients, CEC were higher due to vermicompost application in rice field.

In north-eastern India, particularly in Arunachal Pradesh the application of chemical fertilizers as well as organic manures is very limited. Most of the farmers of this region are economically poor and also most of them are afraid by the hazardous effect of the chemical fertilizers. Traditionally too, the farmers have been practicing organic farming and thus tend to produce good quality food crops. Nevertheless, limited arable lands have posed threat to increased production and eventually farmers have started adopting chemical fertilizer application. Hence soil quality is deteriorating day- by-day, although organic waste could very well be recycled.

This paper discusses the total amount of agricultural waste available in Arunachal Pradesh and estimated tentative amount of compost that can be produced by those wastes for enhancing crop productivity and for sustainable agriculture.

Materials and Methods

A survey was conducted to estimate the amount of feed supply for cattle and buffalo in the five villages of Papum Pare District (27° 60′ N and 93° 31′ E) of Arunachal Pradesh, where farmers have been rearing cattle and buffaloes. From each village 15 households and a total 75 farmers were interviewed purposively to know the feed supply to the cattle and buffalo of several age groups. Data were collected with the help of a pre-tested questionnaire schedule. The feed supply was recorded on the basis of three categories of feed namely green fodder, dry fodder and dry concentrate.

The total amounts of dung and urine excreted by the cattle and buffaloes was calculated from this feed supply. The dung excretions was calculated by taking the digestibility coefficient of 65 per cent for green fodder, 55 per cent for dry fodder and 70

percent for concentrate feeding from the available literature on nutritional trials (Sen, 1953).

The relationship of feed intake to wet dung excretion of cattle and buffalo is given below:

Wet dung (kg) = 0.525 green fodders + 2.25 dry fodders + 1.5 concentrate (kg) —— (I)

The quantity of urine excretion was calculated by following formula,

Urine = 0.677 × wet dung (kg) —— (II)

For other livestock, the total amount of dung and urine excreted was calculated by taking an Indian average data reported by Gaur *et al.* (2002).

The amounts of crop waste of major agricultural crops were worked out on the basis of economic yield (grain, cane or tuber) by the corresponding economic yield: residue yield ratio using the FAO document as cited by Bharadwaj (1995). The yield of crops has been taken from crop wise production data recorded by Department of Agriculture, Government of Arunachal Pradesh (2003-2004).

Results and Discussion

Live stock wastes

The total number cattle and buffaloes available in Arunachal Pradesh on the basis of 17th quinquennial livestock census 2003 were 458173 and 9500 respectively. The average feed for the cattle of Arunachal Pradesh is 12.8 kg green fodder, 1.5 kg dry fodder, 0.3 kg dry concentrate and for buffalo it was 16.1 kg green fodder, 2.0 kg dry fodder, 0.2 kg dry concentrate (Table 1).

By using this feed supply data the annual turnover of dung and urines of cattle and buffaloes of Arunachal Pradesh have been calculated. From table 2, it is clear that annually 1759220 tones (t) of wet dung and 1190699 t of urine are excreted from the cattle and 46187 t of wet dung and 31270 t of urine are excreted by the buffaloes. A huge amount of waste is also arising from other livestock like goat, sheep, pig, poultry etc. On an average, 2221440 t of wet dung, and 1382520 t of urine are arising from

total number of

livestock available in Arunachal Pradesh and the total livestock waste being 3603960 t. From these wastes, 1334800 t of compost (Gaur *et al.*, 2002) could be produced.

Table 1. Average feed supply (in kg) for cattle and buffalo of Arunachal Pradesh.

Category of the animal	Green Fodder (kg)		Dry Fodder (kg)		Dry Concentrate (kg)	
	Cattle	Buffalo	Cattle	buffalo	cattle	buffalo
Young stock	8.21	13.40	1.07	1.62	0.20	0.12
Adult stock	17.41	18.80	1.97	2.44	0.30	0.28
Total	25.62	32.20	3.04	4.06	0.50	0.40
Average	12.81	16.10	1.52	2.03	0.25	0.20

Crop Residues

The agricultural waste available in Arunachal Pradesh which can be recycled easily for increased the productivity and maintain sustainable agriculture are straw, leaves, paddy husk, ground nut husk, sugarcane trash etc. According to agricultural survey conducted by the Department of Agriculture, Arunachal Pradesh (2003-2004), the total cultivated area of rice is 119205 ha and total yield is 135020 t. Out of which 137720 t of straw are produce annually (Table 3). The other cereals like maize, millet and wheat also are cultivated. The pulse crops also yield 5710 t of crop residues. In total 261865 t of straw could be harvested from the cereals and legumes of Arunachal Pradesh. From this agricultural waste, almost 97074 t of compost could be produced efficiently.

Conclusion and Summary

Harvesting of crop removes large quantity of plant nutrients from soil annually. Most of the plant nutrients thus removed can be restored through application of organic manures. Moreover, the soils of northeast India is poor in organic matter and some major nutrients too. So, organic matter recycling is very much essential for maintaining the nutritional status.

In our study we try to estimate the agricultural waste which

our farmers are already familiar. The total estimate of agricultural waste product is 3865825 t in Arunachal Pradesh. From these 143, 1874 t of compost may be prepared. The total cultivated lands of Arunachal Pradesh are 2, 01,000 ha only (Govt. of Arunachal Pradesh, 2003-2004). For this cultivated land area only 20, 01,000 t of compost (@10 t ha^{-1}) is required. So, the compost that could be prepared from easily available waste products of Arunachal Pradesh is enough for maintaining soil nutritional status and for maintaining sustainable agriculture.

Table 2. Estimated amount of dung and urine excreta of livestock available in Arunachal Pradesh.

Sl. No.	Name of livestock	Total no of animals	Dung excretion			Urine Excretion		
			Animal per day (kg)	Total excreta per day (t day^{-1})	Total annual excreta (t)	Animal per day (kg)	Total excreta per day (t day^{-1})	Total annual excreta (t)
1.	Cattle	458173	10.52	4819.98	1759220	7.12	3262.19	1190700
2.	Buffalo	9500	13.32	126.54	46187	9.02	85.67	31270
3.	Goat	231272	0.45	104.07	37990	0.44	100.83	36800
4.	Sheep	16524	0.90	14.87	5430	0.65	10.74	3920
5.	Pig	329882	1.07	352.97	128830	0.96	328.30	119830
6.	Poultry	1214380	0.55	667.90	243780	-	-	-
Total	-	-	-	-	2221440	-	-	1382520

Table 3 Estimated amount of crop waste of some major agricultural crops in Arunachal Pradesh

Sl. No.	Crop	Average grain: straw ratio	Area (ha)	Total Yield (t)	Straw production (t)
1.	Rice	1:1.02	119205	135020	137720
2.	Maize	1:1.5	38610	54810	82215
3.	Millet	1:1.5	22279	21280	31910
4.	Wheat	1:0.65	4150	6630	4310
5.	Pulses	1:0.75	6909	7610	5710
Total					261865

Overall, present estimates substantiate present day agricultural requirement in terms of organic farming practice. However, effective management strategies would be required to be standardized for implementation to enrich soil nutrients for sustainable production in the hilly region of Arunachal Pradesh.

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