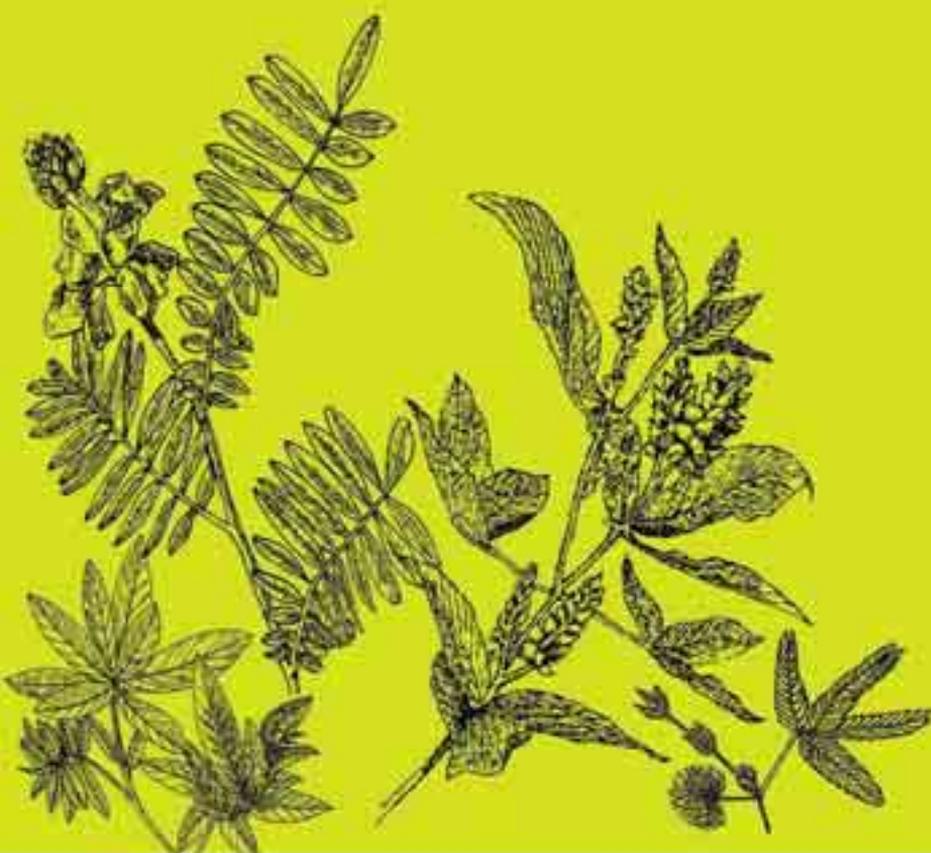


Nature's Bounty

Nitrogen-Fixing Plants for Mountain Farmers

Tang Ya



About ICIMOD

The International Centre for Integrated Mountain Development (ICIMOD) is an independent 'Mountain Learning and Knowledge Centre' serving the eight countries of the Hindu Kush-Himalayas – Afghanistan 🇦🇫, Bangladesh 🇬🇧, Bhutan 🇧🇹, China 🇨🇳, India 🇮🇳, Myanmar 🇲🇲, Nepal 🇳🇵, and Pakistan 🇵🇰 – and the global mountain community. Founded in 1983, ICIMOD is based in Kathmandu, Nepal, and brings together a partnership of regional member countries, partner institutions, and donors with a commitment for development action to secure a better future for the people and environment of the Hindu Kush-Himalayas. The primary objective of the Centre is to promote the development of an economically and environmentally sound mountain ecosystem and to improve the living standards of mountain populations.

Focus on Godavari

The series '**Focus on Godavari**' features information on topics related to the activities of the ICIMOD Demonstration and Training Centre, Godavari. The topics will include background information about technologies, species, and general approaches for integrated mountain development; results of trials and recommendations of appropriate species and technologies; and reports on outreach and training activities both on and off site.

Available titles (December 2004)

- #1 Seeing is Believing: the ICIMOD Demonstration and Training Centre, Godavari (forthcoming)
- #2 Nature's Bounty: Nitrogen-Fixing Plants for Mountain Farmers
- #3 Impact of Contour Hedgerows: A Case Study
- #4 Performance and Selection of Nitrogen-Fixing Hedgerow Species
- #5 Perennial Cash Crops for Mountain Areas (forthcoming)

Nature's Bounty Nitrogen-Fixing Plants for Mountain Farmers

Tang Ya

Focus on Godavari #2

International Centre for Integrated Mountain Development
Natural Resources Management Programme
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Foreword

Focus on Godavari

The International Centre for Integrated Mountain Development (ICIMOD) was established in 1983 amidst increasing concern about environmental degradation and poverty in the Hindu Kush-Himalayan (HKH) region. Its area of mandate is the Hindu Kush-Himalayan region (all or part of the eight countries Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan). ICIMOD's activities focus on the reduction of poverty and the conservation of the natural resource base.

The HKH sustains a population of about 150 million peoples of diverse cultures, the great majority of whom depend upon agriculture as their main source of livelihood. The well-being of mountain peoples is to a great extent determined by the state of mountain agriculture and the potential for economic improvement. Equally, the security of the livelihoods of future generations depends on ensuring that use of natural resources is sustainable, and that the environment is maintained and not degraded.

Mountain agriculture in the HKH is slowly transforming from traditional farming of cereal crops to mixed farming of high-value cash crops and animal husbandry for income. This agricultural transformation poses new challenges, and farmers can no longer rely solely on the wealth of indigenous knowledge acquired over generations. New choices of appropriate crops for the specific local mountain conditions, choices of appropriate methods for land use intensification without upsetting the sensitive balance of fragile mountain ecosystems, new methods of extending agricultural practices to marginal lands that stabilise rather than destroy, increasing the water supply through water harvesting and irrigation, new ways of improving crop productivity and quality without negatively affecting the environment, are technologies that must be tried, tested and integrated within existing farming systems. Many improved technologies have been developed for and promoted in mountain areas with the aim of reducing poverty and conserving



the environment. But as mountain farmers have very limited resources, they are risk adverse and will not invest in an improved technology unless they can assess it carefully first. For technologies to be adopted by farmers they must first be tested and demonstrated in an accessible and convincing way.

ICIMOD established its Demonstration and Training Centre at Godavari, on the southern slopes of the Kathmandu Valley, in March 1993, following the generous provision of 35 hectares of land by His Majesty's Government of Nepal in November 1992. The site provides a place where different technologies and (farming) practices useful for sustainable development can be tested, selected, and demonstrated; where farmers and those who work with them can be trained; and which can serve as a repository for plant germplasm resources and associated floral and faunal biodiversity. Activities in an integrated agricultural system are by their nature cross-cutting and often interactive and interdependent. The activities at the Godavari Centre are linked within a holistic approach that covers a broad range of the possibilities for livelihood – and quality of life – improvement of mountain farmers.

Over the years a large amount of information has been accumulated related to the activities at the Godavari Centre. It includes background information about technologies, species, and general approaches for integrated mountain development; results of trials and recommendations of appropriate species and technologies; training materials; and many others. The series **Focus on Godavari** has been developed to provide a platform for formal publication and wider dissemination of this information. We hope that these books will prove useful to a wide audience, and help provide information that will benefit mountain farmers. We welcome feedback from our readers and new ideas for the series.

J. Gabriel Campbell
Director General, ICIMOD

Executive Summary

Environmental degradation is generally considered to be one of the main obstacles to sustainable development in the Hindu Kush-Himalayan (HKH) region. Agriculture in the HKH is showing a trend towards unsustainability, which has been one of the root causes of poverty in the region. More than three-quarters of the region's inhabitants depend on agriculture for their livelihood, and poverty reduction will only be achieved with sustainable agricultural development.

Nitrogen deficiency is one of the major factors involved in declining soil fertility and land productivity. In many places, chemical nitrogen fertiliser has been used to replenish the soil nitrogen reserve; but continued unselected, and often excessive, application of chemical nitrogen fertiliser has resulted in environmental problems. Equally, in many parts of the HKH region chemical nitrogen is either too expensive or not available. Biological nitrogen fixation offers a simple and cheap method of replenishing soil nitrogen; and nitrogen-fixing plants offer a range of other benefits and opportunities for crop productivity, soil improvement, land reclamation, forest conservation and many others. Promoting the use of nitrogen-fixing plants can contribute considerably to sustainable mountain development. However, in order to be able to exploit the potential of biological nitrogen fixation to the full, it is important first to understand the principles of application, the different types of plants involved, and the different possible uses of these different species in agriculture and forestry.

This book provides a brief description of the principles of biological nitrogen fixation, the different types of nitrogen-fixing plants – leguminous and non-leguminous – and the major potential uses of these plants to support agricultural development in the HKH region. Separate sections are devoted to various means of improving soil fertility, soil conservation, rehabilitation of degraded land, development of woody fodder, development of fuelwood crops, and the use of terrace risers.

The unique characteristics of nitrogen-fixing plants – including their ability to fix nitrogen from the air, to colonise very poor soils, and to act as pioneering plants, fast growth, and their high content of protein, calcium and other nutrients – can be used to help achieve sustainable mountain development by meeting people's basic needs for fertilisers, fodder, and fuelwood, as well as providing an important source of improved nutrition.

Preface

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Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
BNF	biological nitrogen fixation
CHIAT	contour hedgerow intercropping agroforestry technology
HKH	Hindu Kush-Himalaya(s/n)
ICIMOD	International Centre for Integrated Mountain Development
NFP	nitrogen-fixing plants
SALT	sloping agricultural land technology

Contents

Foreword	
Executive Summary	
Acronyms and Abbreviations	

Chapter 1: Nitrogen-Fixing Plants	1
Introduction	1
Biological Nitrogen Fixation	3
Nitrogen-fixing Plants	3
Leguminous species	4
Non-leguminous species	4
Methods of action	5

Chapter 2: Uses of Nitrogen-Fixing Plants	9
Improvement of Soil Fertility	9
Rotation of nitrogen-fixing plants/crops with cereal plants	10
Intercropping of nitrogen-fixing plants/crops with cereal plants	11
Green manure	12
Contour hedgerows of nitrogen-fixing plants	13
Mixed forests	14
Soil conservation	15
Rehabilitation of degraded land	16
Woody fodder	17
Crops for firewood	18
Use of terrace risers	20
Other uses and applications	20

Chapter 3: Conclusions	23
References	24
Further Reading	28

Photo N₂ Plants board, Godavari

before chapter 1

