

# **A STUDY OF TECHNOLOGICAL CHANGE IN ARUNACHAL AGRICULTURE**

**Thesis**  
**Submitted to Arunachal University**  
**in partial fulfilment of the requirements for**  
**The Degree Of**

**DOCTOR OF PHILOSOPHY**  
*In*  
*Economics*



by  
**Bedabrat Salkia**

Under the supervision of

**Dr. N.C. Roy**  
Reader,  
Department of Economics,  
Arunachal University, Rono Hills  
Arunachal Pradesh.

**Dr. B. D. Nayak**  
Faculty of Economics,  
Department of H.S.S.  
NERIST, Itanagar  
Arunachal Pradesh

TS  
0943

NASSDOC

**Arunachal University**  
**2004**



**ARUNACHAL UNIVERSITY**  
**ITANAGAR - 791 111**

Phone : 53

Gram : ARUNIVERSITY

Ref.....

Date.....

**Dr. N. C. Roy,**  
Reader,  
Dept. of Economics,  
Arunachal University,

## ***Certificate***

This is to certify that the thesis entitled "A Study of Technological Change in Arunachal Agriculture" submitted by Sri Bedabrat Saikia, in partial fulfilment of the requirements for doctoral degree in the Department of Economics, Arunachal University is a piece of original work which is the outcome of his systematic research carried out during 2002 – 04. His research is based on primary data collected by a farm level survey in five districts of Arunachal Pradesh.

All his findings from the survey are incorporated in this thesis which has not been submitted elsewhere for any degree. This may be placed before the examiners for evaluation.

*2/8/04*

**(Dr. N. C. Roy)**  
**Supervisor**



पूर्वोत्तर क्षेत्रीय विज्ञान एवम् प्रौद्योगिकी संस्थान  
North Eastern Regional Institute of Science & Technology

(Under the Ministry of Human Resource Development, Govt. of India)

निर्जुली - ७९६१०९

अरुणाचल प्रदेश

Nirjuli - 791109 (Itanagar)  
Arunachal Pradesh, India

क्रमांक/Ref. No. :

दिनांक/Date :


**Dr. B. D. Nayak,**  
Faculty of Economics,

Head, Department of Humanities and Social Sciences,  
NERIST.

## Certificate

This is to certify that the thesis entitled "A Study of Technological change in Arunachal Agriculture" submitted by Sri Bedabrat Saikia, Regd. No.AU/RS-0081 of 2002 w.e.f. 26.04.02 for award of the degree of Doctor of Philosophy of this University is an original piece of bonafied research work done by him under my guidance and supervision. The results embodied in this thesis have not been submitted to any other University for the award of any degree or diploma.

Further, I certify that to the best of my knowledge he bears good moral character.

  
(Dr. B. D. Nayak)

# Preface

Arunachal agriculture, which was based on mainly jhum cultivation, has passed through various stages to reach a new form of farming system, settled cultivation. After independence, the technological horizon of Arunachal agriculture expanded gradually: new inputs were introduced, new agricultural practices were popularised. The gradual extension of permanent cultivation has facilitated the use of new inputs in production. With the rise in the relative importance of permanent cultivation, the agricultural space supportive of technological dynamism has expanded. The extension of permanent cultivation has shaped various new institutions: share cropping, agricultural wage labour, individual ownership of land, etc. To understand the agricultural transition within the domain of technological change I undertook the research on the topic 'a study of technological change in Arunachal agriculture'.

I am indebted to many institutions and people who helped me from the inception to the completion of the study in different ways. At the very outset, I owe a debt of gratitude to both of my supervisors Dr. N.C. Roy, Reader, Department of Economics, Arunachal University and Dr. B.D. Nayak, Faculty of Economics, Department of Humanities and Social Sciences (H.S.S.), North Eastern Regional Institute of Science and Technology (NERIST), Itanagar, for their scholarly guidance, affection and encouragement throughout the course of this research work. Their doors have always been open for answers to my questions, discussions and useful suggestions as well as advice. I would like to acknowledge the constructive criticisms offered by them and their excellent review of the entire

manuscript. It is my proud privilege and pleasure to have free access to the wealth of their wisdom and experience.

I would like to express my gratefulness to ICAR, New Delhi, acknowledging the fellowship. I am highly indebted to my supervisor Dr. B. D. Nayak who gave me the opportunity to avail myself of the fellowship, which made it possible for me to run my research work very smoothly.

I am grateful to the Dr. B.D. Nayak, Head and other faculty members of the Deptt. of H.S.S.,NERIST and Dr. A. Mitra, Head and other faculty members of the Deptt. of Economics, Arunachal University for their continuous encouragement and advice.

I want to record my gratefulness to Dr. Shipra S. Nayak, Research Associate, Deptt. of H.S.S.,NERIST for her constant encouragement, advice and valuable help in my need.

I owe a special debt of gratitude to those who have helped me in carrying out the field survey and collection of the secondary information. I am greatly indebted to Sri P.K.Bhattacharjee, Director, Sri P.C. Bora, Asstt. Director (AC), Sri D.B. Bhatt, Assistant Research Officer, Directorate of Agriculture, Government of Arunachal Pradesh; Smt. Goyi Basar, office bearer, SDAO, Basar; the District Agricultural Officers, the Village Level Extension Workers, Agricultural Field Assistants. I am thankful to the farmers who gave full cooperation during my survey without; their help completion of the study would have been much more difficult. My friend, Robinjyoti Khataniar, my cousins Jun, Rashmi and Jadu gave useful hand in the processing of these data. I am very much thankful to them.

I am also thankful to S. K. Panigrahi, Faculty, M.E. NERIST, Shrinibas Jena, Swadesh Singh, Dulal Bora, Suren Dutta, Kalidas Upadhyay, Ms Rasmi

Bora, Munindra Chutia, Dr. Tankewswar Borua and my cousins Babada and Kanda for their valuable help in my need.

I am indebted to Mr. Hem Chandra Goswami, Principal, Kherajkhat College, Lakhimpur for his encouragement and help in different ways.

I am grateful to the officers and staff of the Central Library, NERIST, Arunachal University Library, K.K. Handique Library ( Guwahati University), Assam Agricultural University Library (Jorhat), Dibrugarh University Library (Dibrugarh), ICAR Library ( Barapani, Shillong) and NEC Library (Shillong) for allowing me to use their library facilities freely.

I would also like to thank Sri Jayanta Thakuria, Sri Deepak Gogoi and Sri Shiji Kumar who helped me in different ways. I am also grateful to the authorities, officers and other staff of Arunachal University and NERIST, who helped me in different ways and provided me an opportunity to undertake the doctoral work.

I want to record my deep sense of gratitude to all my fellow research scholars who have provided me friendship, cooperation and made my time enjoyable.

I also take this opportunity to express my gratefulness to Ms Parijat Bora for her constant encouragement through out the course of the study.

I shall be failing in my duty if I do not acknowledge the responsibility of my family members. I am highly grateful to my parents, elder brother Tulda, Bharati *boa*, younger sister Bhani, younger brother Jan and my nephew Priyanku for encouragement, advice, sacrifice and concern for my academic achievement.

Bedabrat Saikia  
31/3/04  
Bedabrat Saikia

# CONTENTS

	Pages
<i>Preface</i>	iv
<i>List of Tables</i>	xii
<b>1. Introduction</b>	<b>1</b>
1.1 Introduction	1
1.2 Objectives	7
1.3 Methodology	8
1.4 Hypotheses	9
1.5 Limitations of the study	10
1.6 Design of the study	11
<b>2. Review of Literature</b>	<b>13</b>
2.1 Technology, technological progress and agriculture	13
2.2 Origin and characteristics of new agricultural technology in India	16
2.3 Technological change in agriculture and overall economic development	19
2.4 Factors affecting adoption of the new agricultural technology	22
2.4.1 Infrastructure and adoption of new agricultural technology	23
2.4.1.1 Credit facilities and adoption of new agricultural practices	24
2.4.1.2 Irrigation and adoption of new farm technology	24

2.4.1.3	Electrification, transport, education and transfer of new farm technology	25
2.4.1.4	Communication net work, extension service, research system and transfer of agricultural technology	26
2.4.2	Physiographic condition, socio- cultural factors and adoption of modern agricultural practices	28
2.4.3	Farm size and adoption of new agricultural practices	29
2.5	Impact of new agricultural technology	30
2.5.1	Impact of new agricultural technology on income distribution	31
2.5.2	Impact of new agricultural strategy on farm employment	32
2.5.3	New farm technology and farm production	34
2.5.4	New agricultural practices and regional imbalances	37
2.6	Effects of new agricultural strategy on environment	37
2.6.1	Chemical pollution and environmental consequences	38
2.6.2	Irrigation and environmental consequences	40
<b>3.</b>	<b>Nature of Agriculture in Arunachal Pradesh</b>	<b>42</b>
3.1	Agro-Physical Features of Arunachal Pradesh	42
3.1.1	Location	42
3.1.2	Physiography	42
3.1.3	Climate	43
3.1.4	Rainfall	44
3.1.5	Soil	45
3.1.6	Agro- climatic zones and its features	45
3.1.7	Demographic features	47

3.2	Work force	48
3.3	The Nature of Arunachal Economy	49
3.4	The land –use pattern in Arunachal Pradesh	51
3.4.1	Pattern of land holding	57
3.4.2	Nature of property rights in land and tenancy status	57
3.4.3	Cropping pattern and the system of cultivation	60
3.5	Diffusion of New Agricultural Technology in Arunachal pradesh	63
3.5.1	Adoption of HYV programme	63
3.5.2	Trend of application of soil nutrients	64
3.5.3	Plant protection chemicals	66
3.5.4	Availability of irrigation facilities	67
3.5.5	Agricultural marketing	69
3.5.6	Agricultural extension net work, research centers and distribution of hand tool and farm machinery	71
3.6	Area, Production and Productivity of principal crops	72
3.6.1	Paddy	75
3.6.2	Maize	79
3.6.3	Millet	80
3.6.4	Wheat	80
3.6.5	Pulses	81
3.6.6	Oilseeds	81
3.6.7	Spices	82
3.6.8	Vegetables	82

<b>4. Agricultural profile of the surveyed households</b>	<b>85</b>
4.1 The universe of the study and sample	85
4.1.1 Universe of the study	85
4.1.2 Selection of area for field study	85
4.1.3 Selection and composition of the sample	87
4.2 Empirical analysis	88
4.2.1 The size of operational holdings	88
4.2.2 Distribution of sample farmers according to the farming system	92
4.2.3 Land tenure system	93
4.2.4 Labour management and community co-operation	95
4.2.5 Area cultivated, cropping pattern and cropping intensity	95
4.2.6 Paddy cum fish culture	98
4.3 Adoption of New Farm Technology by Sample Farmers	99
4.3.1 Use of high yielding varieties	99
4.3.2 Use of chemical fertilizer in the sample farms	101
4.3.3 Use of bio- fertilizer	103
4.3.4 Irrigation facilities in the sample farms	105
4.3.5 Extent of farm mechanization	107
4.3.6 Adoption of some other improved practices: soil tests and use of pesticides	109
4.4 Productivity of rice in the sample farms	111
<b>5. New farm Technology and Agricultural Growth</b>	<b>117</b>
5.1 Dimensions of technological change in Arunachal agriculture	117

5.2	Determinants of adoption of the new farm technology	119
5.3	Definition of the variables	122
5.4	Discussion of the Regression Results	123
5.5	Impact of Technological Change on Growth of agricultural Production in Arunachal Pradesh	128
5.5.1	Factors affecting on the growth of agricultural production	129
<b>6.</b>	<b>Conclusion</b>	<b>133</b>
	<b>References</b>	<b>139</b>

## List of Tables

<b>Table No</b>	<b>Title</b>	<b>Page</b>
3.1	Classification of the workers of Arunachal Pradesh: 2001	48
3.2	Growth rate of agricultural labourers and cultivators in Arunachal Pradesh	49
3.3	State Domestic Product of Arunachal Pradesh	50
3.4	Net area sown under permanent and jhum land in Arunachal Pradesh during 1970-71 to 2002-03 (Area in hectares)	52
3.5	Operated area under permanent and jhum land in Arunachal Pradesh during 1970 -71 to 2002-03 (Area in hectares)	53
3.6	Growth rate of net area sown in Arunachal Pradesh	55
3.7	Growth rate of operated area in Arunachal Pradesh	56
3.8	Land utilization in Arunachal Pradesh during 1970-71 to 1995-96 (Area in hectares)	58
3.9	Operational holdings in Arunachal Pradesh during 1970-71 to 1995-96	59
3.10	Number and area of operational holdings according to tenancy status in Arunachal Pradesh during 1976-77 to 1995-96 (Area in hectares)	61

3.11	Percentage share of principal crops in total cropped area in Arunachal Pradesh (Area in hectares)	62
3.12	Area under HYV, area under chemical fertilizer, area under plant protection, amount of fertilizer consumed and amount of plant protection in Arunachal Pradesh during 1980-81 to 2002-03 (Area in hectares, quantity in MT).	64
3.13	Estimated trend equations of area under HYV seeds, chemical fertiliser and plant protection measures in Arunachal Pradesh during 1980-81 to 2002-03	67
3.14	Area under irrigation in Arunachal agriculture	68
3.15	Growth rate of area under irrigation	69
3.16	Agricultural extension network in Arunachal Pradesh during 1980-81 to 2002-03	73
3.17	Status of hand tool and farm machineries distribution in Arunachal Pradesh during 1987-88 to 2002-03	74
3.18	Production of the principles crops in Arunachal Pradesh	76
3.19	Production of the principles crops in Arunachal Pradesh	77
3.20	Trend of area under principal crops in Arunachal Pradesh during 1980-81 to 2002-03	78
3.21	Trend of production of principal crops in Arunachal Pradesh during 1980-81 to 2002-03	78

3.22	Trend of productivity of principal crops in Arunachal Pradesh during 1980-81 to 2002-03	79
3.23	Productivity of principal crops in Arunachal Pradesh	83
4.1	Distribution of sample farms according to size of operational holdings (This table includes both jhum and permanently cultivable land)	89
4.2	Distribution of sample farms according to size of operational holdings (This table includes only permanently cultivable land)	90
4.3	Distribution of sample farms according to size of operational holdings (This table includes only jhum land)	91
4.4	Distribution of sample farmers according to the farming system	92
4.5	Distribution of leased area of the permanently cultivable land of the sample farms	94
4.6	Area under different crops, their percentage share in net cropped area and cropping intensity in the sample farms	97
4.7	Number of sample farmers using HYV seeds	100
4.8	Area under HYV paddy	101
4.9	Number of sample farmers using chemical fertilisers	102
4.10	Number of sample farmers using manure	104
4.11	Irrigation facilities in the sample farms of the permanent cultivable land	106

4.12	Distribution of sample farmers according to the method of tilling	108
4.13	Number of sample farmers using pesticides	110
A-1	Farm size and productivity of paddy under permanent cultivation	113
A-1	Farm size and productivity of paddy under permanent cultivation	114
A-2	Farm size and productivity of paddy under Jhum land	115
A-2	Farm size and productivity of paddy under Jhum land	116
5.1	Regression of area under HYV of Paddy on different factors	123
5.2	Regression of productivity on different farm inputs	131
5.3	Regression of Agriculture production on net area sown of permanent land	132