

COST - BENEFIT CONSIDERATIONS FOR IMPLEMENTATION  
OF ERGONOMIC RECOMMENDATIONS.

266-269

LIST OF TABLES

1.	Utilisation of land property in India (1978-79).	3
2.	Comparative Productivity of Paddy per Hectare in Different Countries of the World in Kg in 2Q 1981-1982.	5
3.	Increase of Population and Food Crops Production in India.	8
4.	Production of Tea in India.	8
5.	Daily wage in Different Agricultural Tasks in Paddy Cultivation.	31
6.	Approximate Cost of Seasonal Paddy Cultivation and Productivity in South Midnapur, West Bengal, 1983-84.	34
7.	Percentage of Population of Coastal Zone of Eastern India, who have Different Source of Income other than Paddy cultivation.	35
8.	Family size, Employment and Amount of Cultivable Land per Family of Agricultural Workers.	39
9.	Average Daily Food Intake of the Agricultural Workers Engaged in Paddy Cultivation and Tea-Leaf Plucking Operation.	41
10.	Opinion Survey Score of Agricultural Workers Engaged in Paddy Cultivation in Eastern India Against some Questions on Ergonomical Improvement within their Limits through Modification of existing Methods and Implements used.	48
11.	Physical Fitness Index of Different Categories of Female Tea-Leaf Pluckers.	58
12.	Experiences (yr. ♂), Age and Anthropometric Measurements of Agricultural Workers.	76
13.	Some Observations During Typical Ploughing in Paddy Cultivation.	80
14.	Working Stride Length and Time Taken per Step, During Ploughing Operation, men and Bullocks.	82
15.	Comparative Physiological Responses During Different Operations in Paddy Cultivation, Males and Females.	83

16.	Observations During Drawing-out of Paddy Seedlings.	89
17.	Some Observations During Transplantation of Paddy Seedlings.	94
18.	Some Observations During Paddy Reaping.	104
19.	Ranges of Thermal Environmental Conditions in the Agricultural Fields at Eastern <u>U</u> ttar Pradesh India During the Present Study.	115
20.	Anthropometric Characteristics in Female Tea-leaf Pluckers.	133
21.	Tea-bush Dimensions as Observed During the Study.	136
22.	Physiological Responses of the Female Tea-Leaf Pluckers During Various Conditions.	141
23.	Energy Expenditure of Different Categories of Female Tea-Leaf Pluckers During Various Activities.	145
24.	Reaction Time of the Female Tea-Leaf Pluckers.	147
25.	Illumination Levels Prevailing in the Jorhat Gardens Under Different Conditions.	149
26.	Thermal Conditions Prevailing in the Tea Gardens During this Study (Observed from 07:30 hours to 16:30 hours).	150
27.	Effect of Wearing 'Jhapi' (Locally Made Hat), on Head.	152
28.	Recommended Tea Bush Dimensions Based on Anthropometric Measurements of the Female Tea-Leaf Pluckers.	155
29.	Some Working Dimensions on New Device to Justify Plough Dimensions.	200
30.	Physiological Responses of the Workers During Ploughing Operation Using Existing Design and Modified prototype.	206
31.	Difference Between Existing and Suggested Model of 'Desi' Plough and Discussions in Support of Modifications.	208
32.	Physical Characteristics and Anthropometric Measurements of the Workers.	216
33.	Work Study During Reaping Task with Different Designs of Sickles.	227
34.	Pulse Rate Responses of Male and Female Workers using Different Designs of Sickles.	229
35.	Thermal data During Reaping Operation.	230
36.	Physical Characteristics of the Agricultural Workers.	239
37.	Thermal Conditions During the Study.	240

38. Time and Productivity Studies During Drawing-out Seedling and Transplantating Them, With and Without Using Float-Seat.	241
39. Workers Subjective Assessment of Pain at Different Regions of the Body and Performance of the New Float-seat as compared to the Existing Method Through a Questionnaire Technique.	243
40. Physiological Responses of Agricultural Workers With and Without Using Float Seat.	245
41. Time and Productivity Studies During Drawing-out Seedlings and Transplanting Them, With and Without Using the Leg-cover Physiological Responses	254
42. Physiological Responses of Agricultural Workers With and Without Using Leg-Cover.	255
43. Energy Expenditure, Time Study and Productivity of Female Tea-Leaf Pluckers.	262
44. Criteria for Categorisation of Female Tea-Leaf Pluckers.	263
45. Categorisation of Female Tea-Leaf Pluckers.	266 4

LIST OF FIGURES:

1. Tea and Paddy producing areas in India.	6
2. Yearly rain fall distribution in India.	9
3. Ground Water potential and its use in India.	10
4. Interview with common villagers.	37
5. Food intake in the field during working in agricultural field.	37
6. Water intake in the field during working in agricultural field.	37
7. Variation of blood-sugar levels over the working day in different categories of tea-leaf pluckers.	62
8. Use of globe thermometer in the field for measuring radiation heat prevailing on the worker.	74
9. Dry-bulb and wet-bulb thermometer being used in the field to measure relative humidity.	74
10. Plough and other cultivating equipment <del>are</del> being taken to field.	74
11. Ploughing operation, 'Desi' plough used for cultivation controlled by man and drawn by bullocks.	79
12. Land levelling task is performed by boarding one a clod crusher, pulled by two bullocks. A. in dry field, B. in waterlogged field.	79

13. While land levelling man used to shift his body weight on clau-crusher tying rope towards the bullocks yoke.	79	
14. Drawing out the seedling task by different postures.	88	
15. Transplanting of seedlings.	88	
16. Weeding is an intercultivational task.	88	
17. Spraying of pesticides in the paddy field without using face mask etc. preventive measures.	100	
18. Manual manuring in paddy field.	100	
19. Pumping machines are also used as an irrigation device now-a-days by common farmers.	100	
20. 'Chhipli' an irrigation device commonly used by the farmers.	102	
21. Reaping of the ripe paddy by the help of traditional sickle, showing postural measurement being taken.	102	
22. Head carrying of paddy bundles by the male worker.	102	
23. Head carrying of paddy bundles by the female worker.	109	
24. Paddy bundles are being carried by the help of yoke.	109	
25. Paddy are being threshed turning the paddy bundles round overhead on a specially <u>nurished</u> ground.	109	X
26. Threshing of paddy on a platform.	111	
27. Paddy are being threshed with the help of <sup>e</sup> padal <u>thresher</u> .	111	X
28. Threshing by the help of cows "patul"	111	
29. Cleaning of threshed paddy.	114	
30. Winnowing of dust containing paddy is being done by the help of air-flow.	114	
31. Clean paddy are stored in the common village thatched bamboo-made storage granary - the 'Marai'	114	
32. Transplantation in accurate rows.	119	
33. Use of fertiliser bag as a protective equipment(A) as large plant made hat 'pakhia' (B).	119	
34. Anthropometric dimensions of female tea-leaf pluckers being measured by Martin's anthropometer (B) and of Male agricultural worker (A).	127	
35. Tea-bush dimensions being measured.	127	
36. Resting energy expenditure (while standing) being measured, using OM-12 oxygen analyser.	127	
37. Expired air being collected for measurement of energy expenditure, during plucking.	129	
38. Pulse beats: being collected for measurement of energy expenditure, during walking with : load, using "Jhapi" on head.	129	

39.	Weighing of the subject on a double-pan balance for sweat-loss studies.	129	
40.	Illumination of tea-bush surface being measured.	132	
41.	Female tea-leaf plucker with 'Jhapi' on head.	132	
42.	Photographic records of different methods of tea-leaf plucking.	138	
43.	Typical undesirable postures adapted during plucking, with a basket on her back hanging from her head with a head strap.	132	
44.	A collection of commonly used agricultural implements.	165	
45.	Measurements of existing plough and yoke.	167	
46.	One wing containing moulded blade plough, photograph.	169	
46A.	Bullock drawn mould board plough with dimensions.	170	
47.	Agricultural tools and implements: Racks, spades, hoes etc.	174	
48.	Earthen pots are sometimes used to water the seed bed etc.	169	
49.	"Chhipli" - one of the common irrigation implements,	169	
50.	Dimensions of traditional sickle commonly used in Eastern India.	178	
51.	Plant leaf mop.	182	
52.	Balance containing large iron fulerum and wooden pan being used to weigh bag-ful of paddy.	182	
53.	Plant-leaf made large hat 'pakhia'.	182	
54.	These implements are also used in Indian Agriculture.	185	
55.	New <u>experimented</u> device used for dynamic anthropometry in plough design and design dimensions.	196	X
56.	New ergonomic design of 'Desi' West Bengal Plough.	198	
57.	Use of three handles in new design of plough.	201	
58.	Different positions of hands on handles of existing and modified designs of 'desi' plough and % of total ploughing time taken in each position.	202	
59.	Different types of sickles are in use throughout India, and developed reflex	218	
60.	Trial designs of sickles with lowering blade and handle guard.	221	
60A.	Dimensions of new ergonomic sickle handle and grip (trial model).	222	
61.	New handles of sickle, dorsal and ventral side.	218	
62.	New handles of sickle, side view, left and right.	218	

62. Reaping with the new trial design of sickle showing postural measurement being taken.	223
64. Different sickles being used.	219
66. New trial design being used in grass cutting.	223
63. Reaping efficiency (near to the ground) of traditional and new trial designs of sickles.	224
67. Recommended design of sickle.	231
68. Agricultural work using air-inflated semi-float-seat.	237
69. Agricultural work using leg-cover.	252

#### REFERENCES

	270-313
1. As appeared in the text.	271-300
2. Arranged authorwise.	301-313

#### APPENDIX

List of Publications (Papers, Abstracts and Proceedings)	314-348
A Preliminary Ergonomic Study on Tea Plucking Operations	315-321
Ergonomics study of tea-leaf plucking operations: Criteria for selection and Categorisation.	322-324
An Ergonomic assessment of walking speed and selected Physiological Parameters for Work study application in man.	326-327
Tea-leaf plucking -- workload and environmental studies	328-334
A New Ergonomic Design of A 'Desi' Plough	336-337
Some Anthropometric Considerations Related to Indian Railways Locomotive Drivers.	338-339
Ergonomic Improvements in Indian Agriculture.	341
An Ergonomics study on Sickle design in Indian Agriculture.	343
<i>A New Ergonomic Design of a 'Desi' plough.</i>	<i>344-348</i>