A MULTINUTRIENT PACKAGE FOR TEA PLANTATION WORKERS FOR BETTER HEALTH, PRODUCTIVITY AND PROFITABILITY

TARA GOPALDAS AND SUNDER GUJRAL

TARA CONSULTANCY SERVICES
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Title of the Project : A Multinutrient Package for Tea Plantation Workers for Better Health, Productivity and Profitability.

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Primary Contact at ILSI : Dr. Paula Trumbo
Associate Director, Human Nutrition Institute, ILSI, Washington D.C, USA

Technical Monitor and Adviser : Professor Barry M.Popkin
Professor, Department of Nutrition
School of Public Health, University of North Carolina.

Funder : Opportunities for Micronutrient Initiatives (OMNI) and the International Life Scienc Research Foundation (ILSI) USA.

Project's Technical Teams

Study Estate

Dr. Vijay Kumar, Medical Officer, Study Estate Plantation Hospital
Ms Claramma, Head Nurse
Mr. Micheal, Compounder
Mr. Ratnagar, Head Wardboy
Mr. Ramesh, Adhoc staff

Tara Consultancy Services

Professor Tara Gopaldas, Project Director
Professor Sunder Gujral, Project Coordinator
Mr. K.K. Bansal, Director, Information Systems
Dr. Arati Singh, Research Associate
Dr. S.Ajeet, Research Associate
Dr. A.Santosh, Research Associate
Mr. S.John Suresh, Lab Technician

Support Staff

The Administrative office in-charge of MIS Systems

Support Staff

Ms Malavika Sanadi)
Ms B.Kavita) Secretarial Staff
Mr. V.K.Murthy, Driver

EXECUTIVE SUMMARY

A Multinutrient Package for Tea Plantation Workers for Better Health, Productivity and Profitability

I. The Focus and Objectives of the Study :

⇒ To try and reduce the 'Hidden Hunger' for iron, iodine and Vitamin-A in the entire workforce and their families on a Tea Estate in South India.
⇒ To intervene for nine months with a multinutrient package of supplemental iron and Vitamin-A; and iodized salt.
⇒ To jointly plan and implement the Demonstration cum Research-Action Project with the Management of the said Tea Estate.
⇒ To evaluate the improvement if any, in health, worker productivity and profitability.

II. The Plan of Action and its Implementation :

The Plantation District of Chickmagalur is endemic for Iodine Deficiency Disorders(IDD). It also has high prevalence of Iron Deficiency Anemia (IDA); and Vitamin-A deficiency (VAD). The intervention package consisted, therefore, of all the three micronutrients.

The Study Design :

Balanoor Plantations and Industries Ltd., situated in Chickmagalur district of Karnataka State, South Western India was our Study Estate. The entire workforce of 617 (pluckers and non-pluckers) and their families (approximately 2000-2500 individuals) were the beneficiaries of the micronutrient intervention of 9-months-duration.

The During Intervention period was from August'96 to April'97. The Internal Control for the study was a Pre Intervention period of August'95 to April'96. In addition an External Control Estate (Devon Plantations and Industries Ltd.) was included for the comparison of key agricultural statistics of Rainfall, Crop Yield (kg/ Hectare) and Average Tea Plucked/ worker/ day in the corresponding Pre and During Intervention periods.

The Micronutrient Intervention :

The micronutrients consisted of 240mg ferrous sulphate delivering 60mg elemental iron twice a week; 1600IU Vitamin-A + 400IU Vitamin-D once a week; and heavily subsidized iodized salt (30ppm) for daily cooking for the whole family. The medicinal

supplements of 250 tablets of iron and 125 capsules of Vitamin-A were filled in screw-top plastic containers to last a family of 5 members for 5 months. They were handed over at the Baseline Survey in August'96 to each Worker; and refilled again in December'96 to last another 5 months. The cost of the micronutrients/ family/ year was **Rs.61.50** or Rs.**12**/ family member. Except for Vitamin-A the other two inputs were freely available.

Self -Dosing:

The Workforce was **empowered** and **held responsible** for the dosing of self and all his/ her family members.

Information-Education-Communication (IEC) :

A simple IEC sheet was developed on the dosing regimen and benefits in Kanada (major ocal language) and was distributed to the workforce and supervisors at frequent intervals hroughout the Intervention period. The supervisors/ gang leaders were made responsible o transmit the IEC to their workers/ pluckers.

The Division of Tasks Between the Study Estate and Tara Consultancy Services (The Research Team)

What the Study Estate Did

- Implemented the Micronutrient Intervention.
- Procured the Iodized salt and sold it at a subsidized rate of Rs.2/- kg Vs Rs.5.50 in the open market.
- Maintained the necessary Registers and sent monthly reports to TCS.
- The Medical Officer continuously trained the implementing staff.

What TCS Did :

- Developed the Plan of Action in consultation with the CEO and Management.
- Developed a simple and sustainable research design.
- Oriented the CEO and Management; trained the medical/ health staff.
- Jointly developed the Information-Education-Communication (IEC) in the major local language, Kanada.
- Studied and made use of on-going data systems, namely, hospital registers and computerized Management Information Systems (MIS) on crop yield, average tea plucked, attendance etc.

Collected, analyzed and interpreted Primary and Secondary Source data.

FLOW DIAGRAM OF THE IMPACT OF THE MICRONUTRIENT PACKAGE (IRON + VITAMIN-a + IODINE) ON HEMOGLOBIN LEVELS AND AVERAGE TEA PLUCKED (KG) BY THE FEMALE PLUCKERS OVER THE NINE MONTHS INTERVENTION

(1) % Recieving the Multinutrient Package

Pre	During
N I L	August '96 to December '96 (4-1/2 months) 99% (N=334) December '96 to April '97 (4-1/2 months) 99% (N=334)
Overall 99% (N=334)	

→

(2) % Regularity of Use

During (9 Months Intervention)
Regular 54% (N=180)
Irregular 44% (N=147)
Stopped 2% (N=7)
Overall About half were Regular

→

(3) Hb Levels (g/dl)

Pre	During
Regular 11.1g (N=180)	**Regular** 12.0g* (N=180)
Irregular 10.9g (N=147)	**Irregular** 11.8g* (N=147)
Stopped 11.0g (N=7)	**Stopped** 11.3g (N=7)
Overall 11.0g	**Overall** 11.9g***

→

(4) Average Tea Plucked/ Plucker/ Day (kg)

Months	Pre		During	
	N	Mean	N	Mean
August	327	25.7	315	27.4***
September	313	24.8	322	33.6***
October	326	29.2	315	27.6**
November	324	27.7	321	34.4***
December	326	22.4	315	25.9***
January	313	17.3	268	16.3*
February	311	17.6	317	20.5***
March	305	16.1	288	18.6***
April	322	24.8	302	24.2 NS
	2857	**Overall** 22.90	2763	**Overall** 25.60***

Note : a) About 95% of the sample was available at both the Pre and During Intervention for calculating the Average Tea Plucked. This is reflected at (4)

b) Variation in labour employed and Average Tea Plucked is to be noted over the nine months intervention.

c) Regular is defined as taking the iron supplement two time a week; vitamin-A once a week; and iodized salt daily in cooking Irregular generally meant once a week for Iron and Vitamin-A.

d) 'Stopped' is defined as not taking the iron+vitamin-A; but used the salt.

*** Significant at $p<0.001$, ** Significant at $p<0.01$, * Significant at $P<0.05$, NS Not Significant.

ACKNOWLEDGEMENTS

I thank OMNI-ILSI, USA for awarding us one of their prestigious research grants for designing and executing this 'Plantation Project' in Karnataka, Western India. We could not have had a more warm-hearted and understanding primary contact at ILSI, than Dr.Paula Trumbo, Associate Director of the Human Nutrition Institute, ILSI. We have greatly appreciated the scientific acumen and prompt advice given to us by Professor Barry Popkin, the scientific Monitor and Adviser from the OMNI-ILSI side for this project.

This project would not have seen the light of day if my good friend and neighbour Mr.Dev Mukerjee, former Chairman, Consolidated Coffee, had not introduced me to Mr.Ashok Kurien, the young and dynamic CEO of Balanoor Plantations and Industries Ltd., in 1995. After many visits from Baroda to Bangalore, and many useful discussions with Mr. Kurien, my education on what happens on a Tea-Estate commenced. I have found this young CEO to be a straight shooter. He has kept his word regarding what he and his Management on Balanoor Estate could do and could not do. It has been a pleasure to work with him; the Balanoor Estate Manager, Jeevan Belliappa and his most willing and energetic staff; Dr.Vijay Kumar the Medical Officer of the Plantation Hospital at Balanoor and all his health staff; all the Supervisors or Gang Leaders and all the 617 Workforce and their families who were the target population for this Demonstration cum Research-Action-Project. I am grateful to Mr.Vasudev, Manager of Devon Plantations and Industries Ltd., who very kindly came to our rescue in September, 1997 and provided us with key agricultural and/ other statistics on the Devon Plantations and Industries, which served as our External Control Estate.

This Project would not have been successfully completed but for the untiring efforts of the Coordinator of the Project, Professor Sunder Gujral (my research comrade of innumerable research projects spanning two decades); Mr. K.K.Bansal, Director of Information Systems, Baroda for the never-ending data processing and analysis that was associated with this particular project; my excellent young doctors and the lab-technician who helped us at the Baseline and Resurveys; and the excellent support that the Plantation team obtained from its Management; as TCS did from its support staff.

I would like to thank Dr.K.T.Achaya and Mr.Dev Mukerjee for kindly offering to review the first draft of the report.

Prof. Tara Gopaldas

Date : March, 1998

Director, Tara Consultancy Services,
Bangalore

Chapter One - INTRODUCTION AND RATIONALE

FOCUS OF THE PRESENT STUDY:

The focus of this OMNI-ILSI funded Demonstration cum Research Action Project on "A Multi-nutrient Package for Tea Plantation Workers for Better Health, Productivity and Profitability" was the **Workplace**. Plantations are generally bypassed by the Government's Primary Healthcare system. Further, the focus of this research project was to work as an **equal partner** with the Management of the Tea Estate and to demonstrate to them the **simplicity** and **cost-effectiveness** of the above intervention. The multinutrient package consisted of iron + Vitamin-A supplementation + iodized salt.

India with a total tea production of around 780 million kilograms(kg) in 1996, is the largest **producer of tea in the world**. It accounts for very nearly 30% of the global production of tea. India also happens to be the **largest consumer of tea in the world**. In fact domestic demand for tea has outstripped production inspite of phenomenal technological advances in increasing tea-crop yield or its productivity. The same zeal, however, has not been extended to increasing human productivity although 'plucking' is a highly cost and labor intensive process of tea manufacture. **This step of the manufacturing process accounts for most of the employee costs (1).**

In the sub-continent of India, concentration of plantations, namely, tea, coffee, rubber and spices are the strongest in South India followed by the North-East for tea. Plantations are distinct entities which are managed by large Companies, Corporations, or Single-owners, with management practices of efficiency flowing in a descending order **(2).** The health and welfare of the plantation workers are generally the responsibility of its Management. The plantation sector employs about a million workers who support roughly another 5 million dependents. The Tea Industry is unique in that it employs about 40 to 50% women workers. The permanent work force live on the plantations. Hence, there is great potential to design continuous and large-scale, micro-nutrient and related health interventions for these large 'captive' and 'accessible for services' worker groups.

The United Planters of South India (UPASI) is a highly respected and powerful association of Plantation Managers/ Owners of all types of plantation produce.

They are Worker and Welfare-oriented and are amenable to suggestions to improve the well-being and therefore, the productivity of their workers. In the eighties, UPASI supported a "research-action" project in the tea-plantations of Kerala where Rahamatullah **(3)** demonstrated that the Hb levels of female plantation workers (mostly of the child bearing age) were very low by the Sahli's method (6.1g Hb/ dl). Daily Iron supplementation with Ferrous Sulphate tablets (65 mg elemental iron) **significantly increased** Hb levels and the average plucking yield of tea leaves per supplemented worker also increased. The intervention did not consider the other micronutrients such as Vitamin-A and iodine.

The classical studies of Basta et al **(4)** clearly demonstrated the relationship between Iron Deficiency Anemia (IDA) and productivity of adult male, rubber plantation workers in Indonesia. The Hb concentrations of these workers were 11.0 to 11.9 g/dl. Gardner et al **(5)** also established the interrelationship between physical work capacity (PWC) and work performance among female tea plantation workers (26-62 years of age). A wide variation in Hb concentrations from 6.1 to 15.9 g/dl was reported. In another Sri Lankan study Edgerton et al **(6,7)** reported very low Hb levels in the tea plantation workers of 6.0 to 9.0 g/dl with substantial improvement in plucking performance after iron supplementation. Kalita **(2)** also reported low Hb levels among male and female tea plantation workers of Assam. She reported that an intervention of anthelmentic, iron and vitamin C, had the best impact in raising Hb levels among various combinations of the three inputs **(8).**

The intervention package of iron + Vitamin-A + iodine was selected due to its epidemiological need on the plantations **(9);** and its cost-effectiveness and its excellent success in improving the health and nutritional status of school children in Gujarat, Western India**(10)**.

We would like to **restate** that the central focus of **this** study was **Demonstration cum Research Action**. Its central purpose was to **convince** and **empower** the management and the workers themselves to **continue** with the intervention after we had phased out. Its central purpose was to prove to them and their medical/ health staff that by using well accepted 'Before' and 'After' impact parameters such as hemoglobin status, anthropometric status, dietary and nutrient intake status, clinical status and morbidity status, that it was **possible** to improve the health and nutritional status of the majority of the 600 odd workers and their families (tea pluckers and non pluckers) on the Study Plantation. It was also possible to use the excellent **computerized data** of the Study Estate on crop yield, rainfall, average tea-plucked per worker per day, attendance etc. from their own **on-going Management-Information-Systems (MIS)** to augment our research data. This helped to

convince them as well as us that tea-plucker productivity had indeed gone up. Especially so, as it **had not** in the Control Estate.

We were exceptionally fortunate to have obtained tremendous cooperation and comradeship from our Study Estate - the Balannor Plantations and Industries Ltd. located in the beautiful tea and coffee plantation district of Chikmagalur in Western Karnataka, India. We were also very fortunate to have obtained the cooperation of Devon Plantations and Industries Limited, a sister estate some 30kms away from Balanoor, as our Control Estate for the comparison of some key statistics on rainfall, average crop yield and average tea plucked. Both these estates were managed by the same Corporate House located in Bangalore (the capital city of Karnataka).
In the following chapters we unfold our 'plantation story'.

Chapter Two - OVERALL AND SPECIFIC OBJECTIVES

OVERALL OBJECTIVE :

The overall objective of this Demonstration cum Action Research Project was to demonstrate and evaluate if one could improve the **health, productivity and the profitability** of the workers on a Tea Estate by delivering a simple, cost-effective and sustainable micronutrient package of medicinal iron + Vitamin-A supplementation and iodized salt to **all the workers and their families over a 9-months-intervention period.**

PLAN OF ACTION OBJECTIVES

i. To Develop a mutually agreed upon Plan of Action with the Management of the Study Estate.
ii. To empower and train the Medical and Health Staff of the Study Estate with respect to the procurement and the dosing pattern of the micronutrients; in the maintenance of registers/ records required for the Process Evaluation; and in the conduct of the Impact Evaluation.
iii. To jointly develop a simple Information-Education-Communication System on the Micronutrient Intervention, for the Management, Supervisory staff and the Plantation Workers.
iv. To empower and train the workers to dose themselves and their family members at the household level.
v. To scrutinize the ongoing computerized Management-Information Systems (MIS) of the Study Estate for incorporation into the Plan of Action.
vi. To compare the Study and Control Estates for the Key Agricultural Statistics of rainfall, average crop yield and average tea plucked.

PROCESS, IMPACT EVALUATION AND COST EFFECTIVENESS OBJECTIVE

PROCESS OBJECTIVES

ssues Important to the Management

Average Tea Plucked (kg/ worker per day) in the Pre Intervention Period

(August 1995 to April 1996) and the During Intervention Period (August '96 to April '97).

ii. Percentage Tea Pluckers (matched data) who plucked more in each successive month of the During Intervention Period relative to the Pre Intervention Period.
iii. Number of tea pluckers employed per month in the Pre and During Intervention period.
iv. Month by month absenteeism among the pluckers in the Pre and During Intervention periods.
v. The influence of gangs on the Average tea plucked (kg/ worker/ day) in the Pre and During intervention periods.
vi. Reduction in referral to hospitals in the During Intervention Period relative to the Pre Intervention period.

Additional Issues important to the Research Team

vii. Regularity of use of the Micronutrients in the During Intervention period.
viii. Distribution of the Information-Education-Communication sheet by the supervisors to their workers.
ix. Knowledge of the supervisors and workers regarding the Dosing Pattern of the micronutrients and their benefits.

IMPACT OBJECTIVES :

i. The Impact of the Intervention on the Nutrient Intake of the female pluckers.
ii. The Impact of the Intervention on the clinical signs of iron, vitamin-A and iodine deficiency.
iii. The Impact of the Intervention on hemoglobin status.
iv. The Impact of the regularity of use of the micronutrients and Hb status.
v. The Impact of the Intervention on prevalence of Iron Deficiency Anemia (IDA).
vi. The Impact of the Intervention on the 'plucking average' by the Good, Moderate and Poor Pluckers.
vii. The Impact of the Intervention on Body Mass Index.
viii. The Impact of the Intervention on Common Health Problems.
ix. The Impact of the Intervention on regularity of use of the micronutrients and perceived health status.
x. The Impact of the Intervention on Hb status and attendance.

COST EFFECTIVENESS OBJECTIVES :

i. The cost of the Micronutrient Inputs Per Worker and his/ her family per annum.
ii. Cost of the Micronutrient Inputs per person per annum.
iii. Cost -effectiveness in terms of number of Tea Pluckers employed in the Pre and During Periods of Intervention.

Chapter Three - PARTICIPATORY PLAN OF ACTION

1. THE STUDY ESTATE :

Our Study Estate, namely, the Balanoor Plantations and Industries Ltd. is situated in Chickmagalur district of Karnataka State in South-Western India. It is one of the largest engaged in tea and coffee production.

The Study Estate is situated at an elevation of 1200 feet above sea level. It gets an average rainfall of about 100 inches/ year. It has a total area of 932 acres covering the four villages of Yelemedalu, Murgadhi, Vetebachal Khan and Kulur. Out of its total acreage, a little over 762 acres is under plantations - of which 552 acres are given to tea cultivation and 210 acres to coffee cultivation. The Study Estate has a Tea Factory located on the estate. The Head-Office of the Study Estate is located at Bangalore, the State Capital of Karnataka. The Chief Executive Officer (CEO) is Ashok Kurien who is responsible for the numerous Welfare Schemes for the Workers. At the estate level, the day-to-day operations are carried out by Jeevan Belliappa, the Manager. He is assisted by a Junior Manager, Supervisors, Maistries and the male and female labor force.

The Study Estate employs over 600 workers (male and female; tea-pluckers and non-pluckers). It has been in operation for over a century and possibly has third and fourth generation workers hailing from the plains of Karnataka, coastal Kerala and even the nearby State of Tamil Nadu. The permanent workers who live on the estate have meshed and melled into a distinct 'plantation community' of their own. Four mother-tongues, namely, Kanada, Tulu (a dialect of nearby Mangalore), Malyalam (the mother-tongue of Kerala) and Tamil (the mother-tongue of Tamil Nadu) are all spoken on the estate! The majority of women (about 350) are tea-pluckers in the tea-gardens. The men by way of contrast (about 300) are engaged in the tea-factory, the estate office, for various agricultural duties, and in the growing areas.

As per the Comprehensive Labor Welfare Schemes (CLAWS) proposed by the United Planters of Southern India (UPASI) the Study Estate provides the following to **all** its employees as under :

- ⇒ Free Medical Treatment
- ⇒ Free Creché Facilities

⇒ Sickness Benefit
⇒ Free Housing accommodation
⇒ Leave with wages
⇒ Way expense
⇒ Maternity Benefit
⇒ Family Planning Operation Incentive
⇒ Reading room with new-papers
⇒ A Canteen
⇒ Recreation Expenses

This enlightened estate Management has provided the majority of its workers with free housing (three rooms and a toilet); free electricity; and free potable and piped water. It has also provided for all its employees the following amenities.

⇒ A ten-bedded hospital managed by a fully qualified doctor, Dr.Vijay Kumar, a Head Nurse (Claramma), a Compounder (Micheal); and a Head Ward boy (Ratnagar).
⇒ Two crechés with trained ayahs where the mothers can leave their 'below 3s' and come in at two breaks to breast-feed their infants.
⇒ An Anganwadi or pre-school to cater to the "three to six years-olds" with a trained staff to look after the children.
⇒ A Primary School for the 'above 6 to 12 year-olds' with trained primary teachers.
⇒ A ration shop where rice is issued at a subsidized rate every week. During our 9-months intervention, the Management went out of their way to procure and stock only a reputed brand of iodized salt which was also made available at a subsidized rate (please see later for details).
⇒ A canteen with TV sets, radio, newspapers and various indoor/ outdoor games.
⇒ The managerial staff is provided with beautiful furnished bungalows.

As per the current Labor Acts inforce, a worker has to be paid a minimum wage of Rs.43/- day. A plucker, gets this minimum wage provided he/ she plucks atleast 14kg tea leaves per day. The tea plucker is given a cash incentive for tea-leaves plucked over and above the minimum 14 kg as under :

15 to 20 kg	- 20 paise per kg
21 to 25 kg	- 24 paise per kg
26 and above kg	- 26 paise per kg

It is quite common to see almost all the tea-pluckers pluck well above 25 kg in the crop-rich months of May, June, July, August, September, October and November.

2. THE CONTROL ESTATE :

The Control Estate, namely, Devon Plantations and Industries Ltd., was our Control Estate and was about 30 km away from our Study Estate. It was almost identical in its Management and in the Benefits/ and Amenities given to its employees. It was managed by the same Corporate Group (the well know MRF group) as was the Study Estate. It matched the Study Estate in all infrastructural respects. It also had a Tea Factory on the Estate. It provided the same wages, incentives and all the welfare schemes that come under CLAWS.

It had a smaller area under cultivation with 406 acres under Tea Cultivation and 309 acres under coffee cultivation. It employed 390 women Tea-Pluckers and 150 men non-pluckers.

It was at more or less the same elevation and same geographic location as the Study Estate but received much more rainfall of a little more than 200 inches per year, as compared to the Study Estate (100 inches/ year). Please see a Comparative Statement of both the Estates on 15 indicators, attached at **Annexure A.**

3. VARIOUS STATISTICS AND FACTORS CONSIDERED IN EVOLVING THE PARTICIPATORY PLAN OF ACTION

i. Socio-economic characteristics of the Pluckers and non-Pluckers

From **Table 3.1**, we see that out of the 600 odd workers, the majority were in the mid-age group of 30-50 years; followed by a younger age group of less than 30 years; half were literate (5th to 8th class) and could very well read and understand the simple IEC Sheet (please see **Annexure B).** The great majority did **not** have young children. The great majority were permanent workers and stayed on the estate; were married; had a mean monthly income of nearly Rs.3000/ month; and took advantage of buying subsidized rice from the Estate's Ration shop. In sum, their standard of living was comparable to or even better than a Lower Middle Class family in an Urban Setting.

ii. Management's Views on the Health Problems of their Workers

Informal Participatory Research Assessment (PRA) interviews together with structured questionnaires elicited the following views. Respiratory problems,

gastritis, acute acidity and general weakness/ aches/ pains headed the list; followed by anemia **(Table 3.2).** The Management felt that absenteeism and productivity were certainly affected by the poor health of the workers. This was why they had provided an Estate Hospital with free medical aid, and expensive referral to the nearby big hospitals at Shingeri and Manipal **(Table 3.3).** In the view of the Management, atleast 21% of their workforce absented themselves from work everyday, the major reasons being family responsibilities (100%, especially the women workers); ill health and frequent illness (over 75%); and alcoholism among the men (75%) **(Table 3.4).** However, the concept of 'Preventive Care' appeared to be lacking, even at the Management level.

iii. View of the Medical Officer on the major micronutrient deficiency disorders and health problems prevalent in the worker population.

The Estate Medical Officer, Dr.Vijay Kumar listed iron-deficiency anemia among the women; and mild iodine deficiency disorders as the most prevalent micronutrient deficiencies in the Estate population. Chikmagalur district where the Study Estate is located, has been identified as one of the most endemic districts for IDD disorders in Karnataka **(9).** He stated that gastritis (high acidity) was a very widely prevalent problem. Intestinal helminthic infections were also common in man, woman and child. He concurred with the Management that respiratory problems and general weakness/ tiredness were also often stated reasons by the workers.

iv. Health Problems of the Workers as claimed by them :

Table 3.5 lists aches and pains (65%) as the most pronounced problem. This was followed by helminthic infections (48%); general weakness (17%); obstetrical and gynaecological problems among the women (13%); and infections of the upper respiratory tract (11%).

v. Views of the Supervisors/ Management on the Proposed Micronutrient Intervention

As per the supervisors 99% of the workers were willing to participate in the micro nutrient intervention programme **(Table 3.6).** The management was convinced that the intervention program was sustainable and their workers would be willing to participate in it even if they have to make part payment **(Table 3.7).** However 50% of the managers thought that they would promote the programme to neighbouring estates while the remaining 50% liked to be cautious until the impact of the present intervention was known **(Table 3.8).**

4. DEVELOPMENT OF THE ACTION-PLAN

i. Prelimnary meetings with the CEO and Management of the Study Estate

TCS met with the CEO of the Study Estate even prior to and during the development of this OMNI-ILSI research proposal. TCS found him totally committed to the idea of improving the health of his Workforce. He maintained right through that if the project was even able to demonstrate that the **health of the workers had improved, he would continue with the micronutrient intervention.**

ii. Prelimnary meetings with the Manager, Medical Officer and other staff of the Study Estate

The Manager and his entire staff were very open to the suggestion of a "micronutrient intervention", but the Manager had greater expectations and demands of the micronutrient intervention than did his CEO ! He voiced the feelings of himself and his Management as under :

Issues important to the Tea Management

As a result of the 'micronutrient intervention, in addition to the **'improved health'** of the workers, the Management posed the following questions :

⇒ Would the average tea plucked/ worker/ day go up ?
⇒ Would the Moderate pluckers become Good pluckers ?
⇒ Would the Management be able to hire less workers to pluck more tea ?
⇒ Would absenteeism decrease ?
⇒ Would referral to the nearby hospitals decrease ?

These meetings proved extremely useful to both partners in fleshing out the details of the Action Plan. TCS, in the bargain learnt to appreciate the concerns and expectations of the Management. All the issues listed above, were evaluated in the Process Evaluation (Please refer to Chapter Two on Objectives).

iii. The Micronutrient Intervention :
There was convincing evidence that iron deficiency anemia, iodine deficiency disorders and Vitamin-A deficiency were widely prevalent problems in Chickmagalur District which was home to most of the tea and coffee plantations in Karnataka (**9**). Hence, the major thrust of the Micronutrient Intervention was to

deliver the above three micronutrients to every worker and his/ her family on the Study Estate.

iv. Training and Capacity Building/ Information-Education-Communication
The Medical Officer of the Study Estate was identified as the chief liaison between the Management and TCS. TCS and the Medical Officer jointly evolved the IEC **(Annexure B)** and the Training Component.

v. Procurement of the Micronutrient Inputs:
TCS agreed to procure the iron supplementation and vitamin-A capsules from Bangalore. The Management agreed to provide the iodized salt and sell it at a subsidized rate in their Plantation Ration shop. One kg of Captain Cook iodized salt was sold in the Plantation Rationshop for Rs.2/- kg packet Vs Rs.5.50/- kg packet in the open market.

vi. Payment for the Micronutrient Intervention :
It was agreed that the cost of the package would be shared (50:50). The Management would bear the full cost after TCS phased out. The cost of the micronutrient intervention **per worker and family came to about Rs.61.50/ year.** The iodized salt came to about Rs.31.50; the iron supplementation to Rs.5/-; the Vitamin-A to Rs.10/- and the plastic containers to Rs.15/- per worker and family (3 to 4 family members on an average) for two dosings per annum. Arrangements were made to cater to 700 workers + their families for a five month period or an expenditure of **Rs.35,000/-** per dosing round or **Rs.70,000/-** for the two dosing rounds.

5. IMPLEMENTATION OF THE ACTION PLAN

There was a clear division of labour between the Study Estate and TCS. This resulted in a very smooth functioning of the 'micronutrient intervention'. The Study Estate; in addition, obtained an 'on-the-job-training' over the 9-months-intervention which resulted in a smooth take over after TCS phased out in April 1997.

What the Study Estate Did :

mplemented the Micronutrient Intervention.
'rocured the Iodized Salt and sold it at a subsidized rate of Rs.2/ kg Vs Rs.5.50 - in ıe open market.
Maintained the necessary Registers and sent a monthly report to TCS at Bangalore.
he Medical Officer continuously trained the implementing staff.

The Management at all levels conducted the IEC in Kanada, Malyalam, Tamil and Tulu.
The Gang Leaders monitored and enthused their gangs.
Each worker was made responsible at the family level for dosing of self and family.

What TCS Did :

⇒ Developed the Plan of Action in Consultation with the CEO and Mangement.
⇒ Developed a simple and sustainable research design.
⇒ Oriented the CEO and Management; trained the medical/ health staff.
⇒ Jointly developed the IEC in the major local language, Kanada.
⇒ Studied and made use of on-going data systems, namely hospital registers and computerized Management Information Systems (MIS) on crop yield, average tea plucked, attendance etc. for the Process and Impact Evaluations.
⇒ Collected, analyzed and interpreted Primary and Secodary source data.

Brief description of the Intervention :

i. Approximately 600 odd Workers (Pluckers and non-pluckers) employed by the Study Estate, and their families were the target population for the nine-months-Micronutrient Intervention. (please refer to **Table 3.1**)
ii. The Micronutrient Package and its Dosing Pattern consisted of 240mg ferrous sulphate delivering 60mg elemental iron twice a week (Tuesdays and Fridays) after the evening meal. On the advice of the Medical Officer, it was decided to give the Iron Supplementation two times a week. He felt, and rightly so, that daily iron supplementation would receive a massive negative response due to the high prevalence of gastritis and acidity in the worker population. Further, evidence is **now available** that even weekly supplementation with 60mg elemental iron is sufficient to raise Hb levels **(11-13).** Tuesdays and Fridays were selected, as Hanuman the God of Strength is venerated on Tuesdays; and Lakshmi the Goddess of prosperity is venerated on Fridays **(Table 3.9)** A capsule of 1600 IU of Vitamin-A + 400 IU of Vitamin D once a week on Fridays. Both supplements were given to the Worker for himself/ herself and all the family members over three years of age. Iodized salt (Captain Cook) delivering 30 PPM was made available at the Plantation ration shop. **Table 3.10 shows that nearly 85% received two health check-ups and the 5 month's supply (at a time) of the micronutrients.** The first dosing was done in mid-August 1996 along with the Baseline survey. The second dosing was done in end December 1996.

iii. TCS procured the above medicinal supplements from Pravin Pharma(Wholesale Company) at Bangalore and transported the same twice to the Study Estate. The iodized salt was purchased locally by the Management. The Medical Officer was oriented as to where to procure further supplies of the micronutrients in the quantity and of the quality required.

iv. The IEC sheets were produced in the local language in quantity **(Annexure B).** They were distributed to **all** the workers in advance; at the Baseline, in between and at the Re-survey; and were put up at all vantage points. Gang leaders reminded their gangs to take the supplements and handed over monthly reports on responses/ regularity/ likes/ dislikes to the Medical Officer who took immediate necessary action in counselling those workers who had complaints. The countersigned reports were sent to TCS every month.

v. Preparation of containers for the "Take Home" micronutrients

Small attractive plastic containers with screw caps were purchased. Each container was filled with 250 tablets of Ferrous-sulphate each supplying 60 mg of elemental iron and 125 capsules of Vitamin-A each providing 1600 IU Vitamin-A and 400 IU Vitamin-D. One kilogram of iodized salt (Captain Cook) came packed and labeled by the company. Each worker received one plastic container with the medicinal supplements and one bag of salt for the first intervention period of 5 months. The plantation ration shop stored only Captain Cook's iodized salt. The workers bought it at subsidized rate of Rs.2/-kg. The market price was Rs.5.50/ kg. The containers were refilled for the second dosing and five months of intervention period.

A PARTNERSHIP IN EVERY SENSE

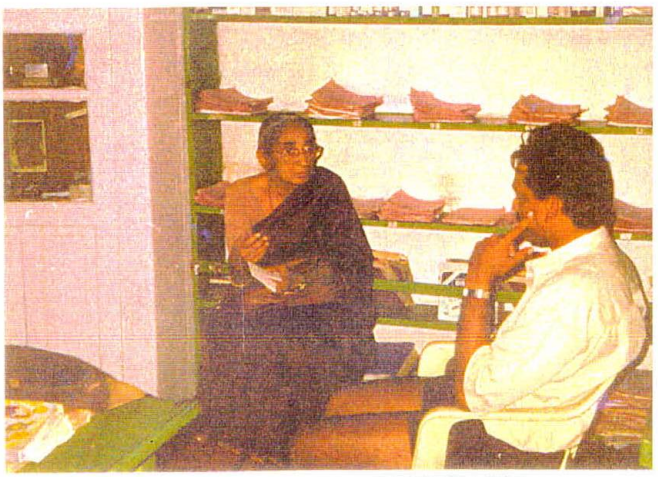
THE ESTATE MANAGEMENT AND THE TCS TEAM PLANNING THE DEMONSTRATION PROJECT

THE GANG LEADERS - THE KINGPINS OF THE ESTATE

THE CUSTODIANS OF THE DAILY COMPUTERISED DATA

THE MOST IMPORTANT WOMEN TEA PLUCKERS

THE EQUALLY IMPORTANT MEN FACTORY AND AGRICULTURALWORKERS



THE ASSISTANT ESTATE MANAGER BEING INTERVIEWED BY PROF. GOPALDAS

FREE FACILITIES FOR ALL ON THE ESTATE

A 10-BEDDED HOSPITAL FOR ALL

FREE MEDICINES AND MICRONUTRIENTS FOR ALL

A CARING AND HAPPY HOSPITAL FOR ALL

A CRECHE FOR THE 'UNDER 3S'

A PRESCHOOL FOR THE '3 TO 6 YEAR-OLDS'

A PRIMARY SCHOOL FOR THE '6-12 YEAR-OLDS'

ANNEXURE A

ITEMS OF COMPARISON		STUDY ESTATE	CONTROL ESTATE
Corporate House, Bangalore		MRF	MRF
CEO of the Estate		Mr. Ashok Kurien	Mr. K.Kurien
Salaries to Workers as per labour Laws in Force		Yes and Same	Yes and Same
Implementation of the Comprehensive Labour And Welfare Schemes (CLAWS)		Yes and Same	Yes and Same
Plantation 10-bedded-Hospital with in-Residence doctor and staff.		Yes	Yes
Number of Women Tea Pluckers		350	390
Number of Male workers		267	150
Acreage Under Tea		552 acres	406 acres
Acreage Under Coffee		210 acres	309 acres
Elevation above Sea Level		1200 ft.	1200 ft.
Tea Factory		Yes	Yes
Crop Yield in	1995 - 1996 (April - March)	2378 kg/ Hct/ annum	2278 kg/ Hct/ annum
Crop Yield in	1996 - 1997 (April - March)	2356 kg/ Hct/ annum	2328 kg/ Kct/ annum
Average Tea Plucked (kg) per worker per day	1995 - 1996 (August - April)	22.90 kg	20.80 kg
Average Tea Plucked (kg) per worker per day	1996 - 1997 (August - April)	25.60 kg	20.80 kg
Annual Rainfall	1995 - 1996 1996 - 1997	99 inches 98 inches	211 inches 244 inches
Rainy Days	1995 - 1996 1996 - 1997	126 days 125 days	121 days 107 days

cynanemethomoglobin method. A digital colorimeter was setup at the Estate Hospital and was later handed over to the Plantation Hospital.

From station three, the subject was sent to station four to receive a 1kg packet of iodized salt and 5 months supply of micronutrients in a container. Each subject was advised to take after his/ her evening meal a black tablet (iron tablet) on every Tuesday and Friday and the red capsule (Vitamin-A) on every Friday. Also to give the same to all his/ her family members (above 3 years of age) as described. The subjects were explained the benefits of the micronutrients and iodized salt. They were asked to report any ill effects if any, of taking the tablets particularly the iron tablet.

Dosing pattern

The second round of dosing was done four and a half months after the first round. The dosing procedure remained the same as in the first round. Each subject was re-explained the benefits of taking the health inputs regularly and was asked if he/ she had suffered/ suffer from the ill effects of these tablets particularly the black tablet (iron tablet).

It was noted at the Baseline Dosing, that many families had two and sometimes three pluckers per family. Hence adjustments were made in handing out the plastic containers (with micronutrients) and the salt packet, depending on the need of the family. This was duly noted in the Dosing Register.

Details of the procedures used

i. Anthropometric measurements :

Body Weight : The subject was weighed with normal clothing to the nearest 0.5 kg using Krup's weighing scale **(16).** The scale was adjusted to zero each time the subject was weighed.

Body Height : Height was measured nearest to 0.1cm with the help of a non Stretchable measuring tape affixed on a smooth surfaced wall.

Body Mass Index (BMI) : Waterlow's classification **(17)** was employed for nutritional categorization of the subjects based on their BMI. A cut off point of equal to or above 18.5 indicated normal nutritional status. While a BMI of less than 18.5 was taken as indicative of under-nourished status. BMI was calculated using the formula, Weight (kg) by Height^2 (m).

ii. **Clinical examination :** All subjects were examined for eye signs of vitamin-A deficiency using the "Field Guide to the detection and control of Xerophthalmia" **(18).** The ocular signs of vitamin-A deficiency were classified as follows.

XN	Night Blindness
XIA	Conjuctival Xerosis
XIB	Bitots spot
X_2	Corneal Xerosis

iii. **Presence of Anemia :** An anemia recognition card (cards were obtained from the Voluntary Health Association of India) was used to determine the prevalence of anemia.

iv. **Iodine Deficiency Disorder (IDD) :** The subjects were clinically examined for the presence of clinical and subclinical manifestation of iodine deficiency **(19).**

v. **Hemoglobin estimation :** The cyanmethomoglobin procedure as described by Oser (1976)**(20)** was used for hemoglobin estimations. Hemoglobin level of less than 12g/dl in adult female and children aged 6-14 years, less than 13 gm/ dl in adult male and less than 11g/ dl in children below 5 years of age was taken to be indicative of iron deficiency anemia**(21).**

II. Data Processing and Analysis

Data Entry and Validation

The Data were entered using Foxbase and data files were created. The data were checked and validated for internal consistency. Separate files were created for Attendance and Pluckability data.

Tabulation and Statistical Analysis

SPSS was used for tabulation and statistical analysis. SPSS commands were written to describe all variables and specify missing values. SPSS commands to produce tables were written and tested. SPSS commands were written to apply statistical tests namely t-test, Chi square test, Pearson Correlation and Analysis of Variance. Finally when the complete data set was ready, Tables were produced and Statistical Analyses were carried out. All tests were considered significant at $p<0.05$. The graphical presentation of data in the form of Bar and Line charts was done by using Harvard Graphics.

NUTRITIONAL ASSESSMENT AND MICRONUTRIENT DISTRIBUTION

THE PLANTATION DOCTOR AND PROF.GUJRAL INTERVIEWING A WOMAN TEA-PLUCKER

THIS TEA PLUCKER HAD BILATERAL BITOT'S SPOTS, WAS NIGHT-BLIND AND HAD A VERY POOR DIETARY INTAKE OF VITAMIN-A

THIS PLUCKER HAD MILD GOITRE

HEMOGLOBIN OF A MALE PLUCKER BEING ESTIMATED BY THE CYANMETHEMOGLOBIN METHOD

THE HEIGHT OF A WOMAN TEA-PLUCKER BEING RECORDED

COUNSELLING AND DISTRIBUTION OF MEDICINAL IRON,VITAMIN A AND D SUPPLEMENTS TO LAST THE WORKER AND FAMILY FOR 5 MONTHS

Chapter Five - Results

Section A : Comparison of Key Agricultural Statistics in the Study and Control Estates in the Pre and During Intervention Periods.

From Annexure A, Chapter Three, it is evident that the Study and Control Estate were very similar in almost all the fifteen indicators of comparison.

In this chapter, we present comparative data on Rainfall; Crop Yield (kg/ Hectare); and Average Tea Plucked (kg/ worker/ day) in the Pre Intervention Period (August 1995 to April 1996) and the During Intervention Period (August 1996 to April 1997) in the Study and Control Estates.

From **Table 5.1** one notes that the Control Estate was much better endowed with rainfall in both the Pre and During Intervention periods as compared to the Study Estate. The **no rainfall** or extremely **scanty rainfall** months for **both** the estates commenced in November and continued upto March.

Table 5.2 and **Figure 5.1** show that the overall crop yield in both the estates during both the Pre and During Intervention periods were almost identical. The month by month crop yield followed the rainfall pattern.

Table 5.3 and Figure 5.1 establish that inspite of the Overall Crop Yields being almost identical (**Table 5.2**), the Average Tea Plucked in the Study Estate was **significantly better** in its During Intervention Period as compared to its Pre Intervention Period. The plucking average went up from 22.9 kg/ worker/ day to 25.6 kg per worker per day. By way of contrast the plucking average was 20.80 kg/ worker/ day in the Control Estate in its Pre-Intervention Period. It stagnated at 20.69 kg/ worker/ day in the During Intervention period.

Table 5.4, establishes that there is a **significant relationship** between Average kg eaves plucked and Crop yield. The bountiful 'plucking months' on **both** the estates were August to December. The lean 'plucking months' on both the estates were January, February and March.

Scrutiny of **Table 5.3**, however shows that in some crop-bountiful months such as October (1996), the plucking average was **less** in the During Period, in the Study Estate. This is even **more** apparent in the Control Estate, where the 'plucking average' was poor in the crop-rich months of August 1996 and October 1996. This points to **occasional** and **extraneous** reasons that may bring down the 'Average Tea Plucked/ worker/ day'.

A comparison of the Study and Control Estates on the three Key Agricultural statistics shows the following :

⇒ Rainfall actually favoured the Control Estate.
⇒ The Crop Yield in the Study and Control Estates were almost identical in both the Pre and During Intervention periods in **both** the Estates. Hence, this most important factor is **controlled for**.
⇒ The Average Tea Plucked went up significantly in the Study Estate. It stagnated in the Control Estate.
⇒ Our conclusion, therefore, is that our 'micronutrient-intervention' of iron + iodine + Vitamin-A did have a positive effect in increasing the labour productivity and 'average tea-plucked'.

We must bear in mind that the plucker received a **package of micronutrients** - not iron alone. It must also be borne in mind that Chickmagalur is an iodine endemic area. The consumption of the iodized salt must also have contributed to better 'plucking averages'. Lastly the overall mean hemoglobin levels of the 'pluckers' were adequate at 12.0g/ dl at Resurvey. This has also contributed to better physical work capacity and consequently to significantly better 'plucking averages'.

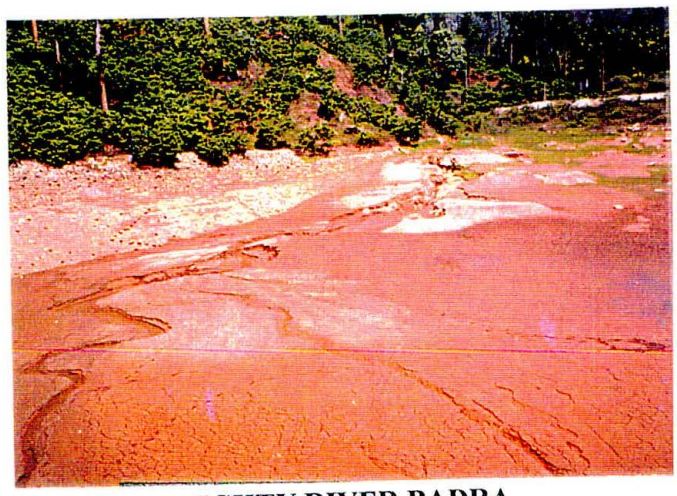
TEA CULTIVATION IS SCIENTIFIC BUSINESS

WELCOME TO BEAUTIFUL
BALANOOR ESTATE

NURSERIES FOR TEA SEEDLINGS

THE TEA PLANTS HAVE
GROWN A LITTLE BIGGER

LIGHT, SHADE, TEA BUSHES AND
TREES - NATURE'S GREAT TEAM



MIGHTY RIVER BADRA
EVER FULL AND FLOWING

Section B : Results of the Process Evaluation.

This section will discuss data and results pertaining to the Study Estate only.

Issues Important to the Management

i. Average Tea Plucked (kg/ worker per day) in the Pre Intervention Period (August 1995 to April 1996) and the During Intervention Period (August '96 to April '97).
ii. Percentage Tea Pluckers (matched data) who plucked more in each successive month of the During Intervention Period relative to the Pre Intervention Period.
iii. Number of tea pluckers employed per month in the Pre and During Intervention period.
iv. Month by month absenteeism among the pluckers in the Pre and During Intervention periods.
v. The influence of gangs on the Average tea plucked (kg/ worker/ day) in the Pre and During intervention periods.
vi. Reduction in referral to hospitals in the During Intervention Period relative to the Pre Intervention period.

Additional Issues important to the Research Team

vii. Regularity of use of the Micronutrients in the During Intervention period.
viii. Distribution of the Information-Education-Communication sheet by the supervisors to their workers.
ix. Knowledge of the supervisors and workers regarding the Dosing pattern of the micronutrients and their benefits.

i. Impact of the Micronutrient Intervention on the Average Leaves Plucked (kg/ plucker/ day) in the Pre and During Intervention periods in the Study Estate.

Tables 5.5 and 5.6 and Figure 5.2 clearly shows that the average tea plucked (kg/ worker/ day) was **significantly higher at 25.6 kg Vs 22.9 kg** in the nine months of micronutrient-intervention. Furthermore, this **significantly higher** plucking level **was sustained for six months out of the nine months of intervention**, except for the months of October 1996, January 1997 and April 1997, where possibly other considerations took precedence.

In the previous Section A, Chapter 5, we had presented data to show that the significant rise in the 'plucking average' in the Study Estate, during the nine-months micronutrient-intervention period was indeed a true effect. The month by month statistical analysis further substantiates this.

ii. Percentage Tea Pluckers (matched data) who plucked more in each successive month of the During Intervention period relative to the Pre-Intervention period.

Figure 5.3, shows that crop yield was virtually the same in both the Pre and During Intervention periods. In fact it was slightly lower at 1608 kg/ Hectare in the 9-months- micronutrient intervention period vs the Pre, where it was 1668 kg/ Hectare. In spite of this **slight disadvantage** to the pluckers, 64% of them on **matched data**, plucked atleast **one kg more** as a result of the micronutrient-intervention. Further, this was not a chance effect. **Figure 5.1** shows that even in the 'crop lean months' of January to April, 55% of the pluckers 'plucked more'. The question could well be posed as to How so ? and Why so ? Our data and results point to the **increased pluckers' productivity** due to the **total package of the micronutrients, namely, iron + iodine + Vitamin-A.**

iii.Number of tea pluckers employed per month in the Pre and During Intervention period.

Table 5.7 and Figure 5.4, shows that 2867 pluckers were employed from August 1995 to April 1996. In the Intervention period, 2763 were employed **or 104 less pluckers** on a monthly basis. A scrutiny of the month by month data show that except for September 1996 and February 1997, **less pluckers overall were deployed to pluck more tea leaves**. September 1997 was a peak crop yield month, with a better crop in this Intervention month Vs its corresponding yield in the Pre-month. Ninty three percent of the pluckers plucked more. The average tea plucked was a whopping 33.6 kg/ worker/ day Vs 24.8 kg in the Pre-month. Possibly the bounty of the crop entailed the employment of more pluckers, inspite of the commendable performance of most of the pluckers. The largest number of workers (45) were **reduced** in the month of January 1997. January is traditionally a 'crop bleak' month. **Figure 5.1** shows that the crop was also very poor.
But overall, the Management deployed **104 workers less** which translates to quite a fair amount of financial saving (please refer to Section D on Cost-Effectiveness).

A survey of the literature indicates that the highest productivity among workers was achieved in the second month of iron or iron + helminthic interventions. (All these classical studies had a duration of only 2 to 4 months intervention **(4,7,22).**

iv. Month by month absenteeism among the pluckers in the Pre and During Intervention periods

Table 5.8 and **Figure 5.5**, reveal that the level of absenteeism **did not change** and stood at a **high 27%** in both the Pre and During intervention periods. The month where absenteeism peaks, more or less corresponds with the 'crop lean' months of January, February and March. However, there does not seem to be any discernible pattern for taking leave. It would appear that the pluckers take all the leave they are entitled to, regardless of their being in a fit or unfit state of health.

v. The influence of gangs on the average tea plucked (kg/ worker/ day) in the Pre and During intervention periods.

Table 5.9 does **not** reveal any significant difference in the average tea plucked (kg) per worker per day **between** gangs in the Pre and During intervention periods. Pluckers in gangs 1, 4, 5 and 6 plucked **3 kg more** in the During Intervention period, as against gangs 2,3,7 and 9, who plucked **2 kg more**. This difference was not found to be significant.

All that we can conclude is that the supervisors of the 9 gangs appeared to exert more or less the same influence over their gangs as far as 'tea plucking' went.

We again draw attention to the fact, that the 'plucking average' did go up **significantly overall** from 22.9 kg in the Pre Intervention period to 25.6 kg in the During Intervention period. Since, crop-yield **(the most significant factor for plucking' was the same)** in the Pre and During intervention periods, we again conclude that the significant increase in average tea plucked was due to the **micronutrient intervention**.

i. Reduction in referral to hospitals in the During Intervention Period relative to the Pre Intervention Period

Table 5.10 reveals that illness or disorders that could have been influenced by our micronutrinet intervention of iron + iodine + Vitamin-A **did indeed decrease**. Referrals to the nearby hospitals such as Manipal and Shingeri, for conditions such

as general weakness/ aches/ pains; loss of appetite; GIT problems; gastritis; peptic ulcer/ liver problems; goitre and anemia **did decrease**. Referral for respiratory problems and general check-ups **did increase**. However, **overall there was a reduction in referral to the nearby large hospitals by 26%.**

Additional Issues important to the Research Team

vii. Regularity of use of the Micronutrients in the During Intervention period

Table 5.11 depicts that the majority, namely, 58% of the subjects were **regular** in taking the iron + Vitamin-A supplementation. Of the remaining, 33% were irregular and 9% stated that they had stopped taking the supplements after 1 or 2 months. The Table also brings out the gender variations in the regularity of use of the supplements. Among the **Pluckers**, the few male pluckers were more regular in taking the supplements (71%) than were the female pluckers (54%). The same pattern extended to the **Non-Pluckers**. The regularity of use among the males was 63% Vs 41% among the females. This pattern extended to the elderly male and female dependents. However, what was very encouraging to see was that the parents were very particular about dosing their children as 83% were regularly dosed. Our data show that it did not appear to make so much of a difference in raising Hb levels, whether a subject took the iron and Vitamin-A supplements **two times (Regular)** or **once a week (Irregular)** as the Hb levels rose by about one gram in the women pluckers and by about two grams in the male workers (pluckers or non-pluckers). In any case Baseline Hb levels were quite decent at about 11g/ dl and 12g/ dl respectively in the women and men. (**Table 5.18** Section C, Chapter Five). The ones who **stopped** taking supplements (30 to 40%) were the **female non-pluckers** and the **elderly dependents.**

Fortunately, all members of the family got the iodine on **regular basis** through the fortified salt.

viii. Distribution of the Information-Education-Communication (IEC) sheet by the supervisors to their workers

Table 5.12 shows that there was a lively interest among the supervisors in distributing and explaining the IEC sheet (Annexure B, Chapter Three), to their workers. Almost all claimed to have done this. This was corroborated by the fact that **almost all** the workers quizzed by the examination team at Resurvey, knew

exactly what each micronutrient was expected to do for the improvement of their health. But many insisted that their gastritis problem had been aggravated **(Table 5.23).**

ix.Knowledge of the supervisors and workers regarding the dosing pattern of the Micronutrients and their benefits

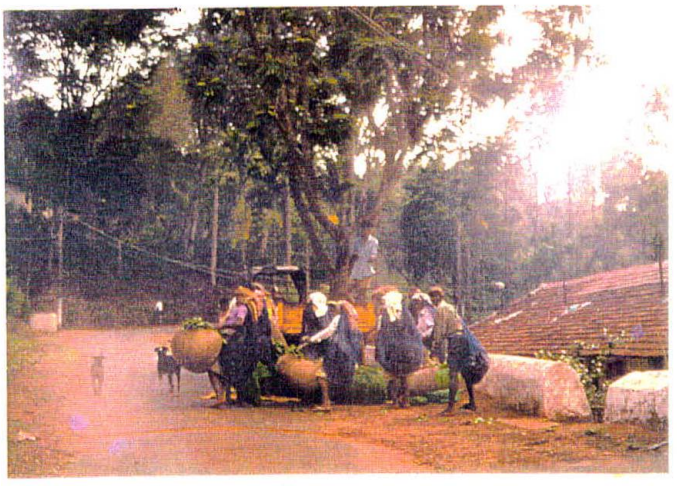
Table 5.13 and **Figure 5.6**, depicts that the IEC sheet was a successful communicator, as all the supervisors, and the sub-sample of workers had a very clear perception of the dosing pattern of the micronutrients and the benefits they would derive from the same.

THE DAILY LIFE OF WOMEN TEA PLUCKERS

WOMEN TEA PLUCKERS - BACKBONE OF THE ESTATE AND THEIR HOUSEHOLDS

HEAVY LOADS OF PLUCKED TEA LEAVES - A STRAIN FOR HEADS, NECKS, BACK AND LEGS

PLUCK, PLUCK, PLUCK FROM DAWN TO DUSK



OFF TO WEIGH THE TEA LEAVES AND EARN THEIR DAILY WAGES

THE SHEER JOY OF SUBSTANTIAL DAILY WAGES

SOMETIMES WE CAN'T GO TO WORK BECAUSE OF A SICK BABY

Section C - Results of the Impact Evaluation

In this section we will discuss data and results pertaining to the **Study Estate only**. The **Impact Results** are presented as under :

i. The Impact of the Intervention on the Nutrient Intake of the female pluckers. (Table 5.14)
ii. The Impact of the Intervention on the clinical signs of iron, vitamin-A and iodine deficiency.(Tables 5.15,5.16, 5.17)
iii. The Impact of the Intervention on hemoglobin status.(Table 5.18)
iv. The Impact of the regularity of use of the micronutrients and Hb status.(Table 5.19)
v. The Impact of the Intervention on prevalence of Iron Deficiency Anemia (IDA) (Figures 5.7, 5.8, 5.9, 5.10)
vi. The Impact of the Intervention on the 'plucking average' by the Good, Moderate and Poor Pluckers.(Tables 5.20, Figures 5.11 and 5.12)
vii. The Impact of the Intervention on Body Mass Index. (Tables 5.21 and 5.22)
viii. The Impact of the Intervention on Common Health Problems.(Table 5.23 and Figure 5.13)
ix. The Impact of the Intervention on regularity of use of the micronutrients and perceived health status.(Table 5.24)
x. The Impact of the Intervention on Hb status and attendance.(Table 5.25 and Figure 5.14)

Nutrient Intake of the Sub-sample of Female Pluckers in the Baseline and Resurvey in the Study Estate

Table 5.14 shows that the nutrient intakes of all the macro and micronutrients have increased **significantly.** The ongoing informal Nutrition Education given by the Hospital staff and Research team also had some beneficial effect. This is supported by statements that 'appetite had improved' **(Table 5.24)** and by the Body Mass Index also improving (> 18.5), though not significantly, from 37% at Baseline to 42% at Resurvey **(Table 5.21).** However, the dietary nutrient intake of iron still remained at a low 38%; and that of dietary vitamin-A at an even lower 27% at Resurvey. Hence, it would appear that the only feasible way at the **present time** to improve the iron and Vitamin status of Plantation workers, especially its women pluckers, is through **supplementation** or **fortification**.

In informal discussions, the Management was of the opinion that multi-fortified foods, such as double fortified salt, vitamin-A and D fortified cooking oil, which could be easily procured and stored in the Plantation Ration Shop, would be the best.

ii. a) Impact of the Micronutrient Intervention on Clinical signs of Iron Deficiency in the Pluckers, Non-Pluckers and Children in Study Estate.

Table 5.15, depicts that the clinical signs of pale conjunctiva and nails reduced significantly in the worker population (plucker and non-plucker) from 47% to 10%; the corresponding figures for children (6-12 years) was 65% to 20%. The significant **improvement** in Iron Deficiency Anemia status is corroborated by **Tables 5.18, 5.19 and Figures 5.7, 5.8, 5.9 and 5.10.**

ii. b) Impact of the Micronutrient Intervention on clinical signs of Vitamin-A deficiency in the Pluckers, Non-Pluckers and children in the Study Estate

Table 5.16 reveals that the pre-clinical and/ or clinical signs of Vitamin-A (Night blindness, Conjuctival Xeroxis and Bitots spots) reduced from 19% at Baseline to 4% at Resurvey. In the Pluckers (almost all women) all the signs reduced significantly i.e. Night Blindness reduced from 9 to 2%; Conjuctival Xeroxis from 8 to 2%; and Bitot's spots from 2 to <1%. In the non-Pluckers (mostly men) all signs reduced significantly i.e. Night Blindness reduced from 10 to 2%; Conjunctival Xeroxis from 9 to 1%; and Bitot's spots from 3 to <1%. In children the non-significant reduction was 6 to 3%.

The nutrient intake data of the women Pluckers **(Table 5.14)** depicted the very poor Vitamin-A status of these women. At Baseline their nutrient intake of Vitamin-A status was just 21% of RDA. The Research Team noted that the meals were monotonus and consisted of huge helpings of rice and lentil curry. Very little milk, vegetables or fruits were consumed. Fish was eaten occasionally. On account of the Nutrition Education and improved appetite, retinol intake went upto 27% of RDA. The Vitamin-A supplement of 1600 IU, if it was taken weekly, would have added 30 IU or 69µg of retinol or Vitamin-A to the meager 165 µg retinol, from the daily diet-bringing it upto 239µg or about 40% of the RDA.

Further, all the cases identified as Vitamin-A-deficient were 'Active signs'. They

manifested night blindness (XN) in conjuction with conjuctival xeroxis (X1A) and/ or Bitot's spots (X1B).

ii. c) Impact of the micronutrient intervention on Clinical signs of Iodine Deficiency in the Pluckers, Non-Pluckers, and Children in the Study Estate

Table 5.17, shows that **overall** 17% manifested signs of mild iodine deficiency (small nodules at base of the neck) at **Baseline**, which reduced significantly to 7% at Resurvey. In the Pluckers the significant reduction was from 18 to 10%; in the non-Pluckers the significant reduction was from 20 to 5%. No child manifested a clinical sign of iodine deficiency at Baseline; one did at Resurvey.
On the whole one could say that the use of iodized salt by the whole family did have beneficial effects on its Iodine Deficiency Disorders status.

iii.a) Impact of the Micronutrient Intervention on Hemoglobin status of the Pluckers, Non-Pluckers and Children in the Study Estate.

Table 5.18 shows that the mean hemoglobin levels in the females significantly rose from 11.0g/dl at Baseline to 11.9 g/dl at Resurvey. In the males it was even more impressive, where there was significant rise of 12.1g/ dl to 14.0g/dl. Among the children, there was a non-significant rise from 10.8g/ dl to 11.6g/dl.

To restate, some facts regarding the iron status of this Plantation population emerges:

⇒ The **Baseline** mean Hb values of the Pluckers (almost all women); non-pluckers (almost all men); and children were **not low** to start with.
⇒ The empowerment of the workers to dose themselves and their families appears to have worked well on the whole.
⇒ A very small percentage of the workers (2%) stopped dosing themselves or their families. The rest dosed themselves with the iron and Vitamin-A supplements either twice a week or once a week. Either schedule appears to have had a similar impact on enhancing Hb levels.
⇒ This resulted in a mean rise of nearly 1g/ dl among the women; and nearly 2g/dl among the men. In the children (>3-12 years) who were most regularly dosed by their parents, a mean rise of nearly 1g/dl was again noted.

We conclude the micronutrient intervention jointly evolved by the Study Estate and us (TCS), proved to be simple, effective and sustainable.

iv.a) Impact of the Regularity of use of the Micronutrient Intervention and Hb status

Table 5.19 reveals that the Hemoglobin levels rose significantly among the female pluckers and non-pluckers. In the female pluckers, it rose significantly from 11.1g/ dl to 12.0g/ dl among those who were regular in taking the medical supplements. It rose from 10.9g/ dl to 11.8g/ dl among the female pluckers who were irregular and took the medicinal supplements only once a week or off-and on. We, therefore, conclude that it did not make an appreciable difference whether the subject dosed herself once or twice a week. Among the few who had stopped taking the supplements there was a non-significant rise from 11g/ dl to 11.3g/ dl.

In the case of the men workers, who were much more regular than the women in taking the supplements, their Hb levels rose by about 2g/ dl (non-significantly) in all the three groups of Regular, Irregular and Stopped taking.

v. a) Impact of the Micronutrient Intervention as Indicated by a Reduction in Iron Deficiency Anemia (IDA) in Female, Male Pluckers and Non-Pluckers and their Children in the Baseline and Resurvey in the Study Estate

Figure 5.7 demonstrates that there was a highly significant reduction in Iron Deficiency Anemia among the Female, Male and Child population on the Study Estate. It was surprising to note that 98% of the Female and 100% of the Child subjects were **anemic** at **Baseline**, inspite of the mean Hb value appearing to be fairly adequate at a mean 11g and 10.8g/ dl respectively (WHO cut-off ≥ 12g/ dl). IDA was widely prevalent at Baseline among the male population as well. (WHO cut-off ≥ 13g/ dl) There was highly significant reduction in **IDA** in **all** the three population groups at **Resurvey**.

v. b) Impact of the Micronutrient Intervention on the shift in the Hemoglobin Status Distribution Curve in Pluckers, Non-Pluckers and Children in the Study Estate

Figures 5.8, 5.9 and 5.10 clearly shows that there was a noticeable shift to

the right in **all** the three distribution curves.

The male pluckers were clearly the most benefited by the Micronutrient Intervention. The WHO cut-off used was 13g/ dl.
The Female Pluckers and Non-Pluckers came next; followed by the children. The WHO cut-off was 12g/ dl.
The Women especially the Non-Pluckers were not very Regular in dosing themselves. However, the Regular dosing was as high as 83% where the children were concerned. The relatively subdued distribution curve for children may suggest a high level of intestinal helminthic infection or some other problem which may have to be concurrently addressed.

vi. a) Impact of the Micronutrient Intervention on Average Leaves Plucked (kg/ plucker/day) by the Good, Moderate and Poor Pluckers and their Hemoglobin levels in the Study Estate

Table 5.20 demonstrates that the Good Pluckers (plucking more than 25kg/ day) plucked significantly more, namely, an average of 29.3kg/ plucker/ day with a mean Hb value of 11.9g/ dl than what they had in the Pre-Intervention period. In the former period the average tea plucked was 28.1kg with a mean Hb level of 11.1g/ dl. We clubbed the Moderate and Poor Pluckers (Moderate = 14 to 25 kg; Poor = Less than 14kg/ day) as there were only 5 Poor Pluckers. The average tea plucked went up significantly from 19.9kg to 21.7kg. The mean Hb levels also rose significantly from 11.0g to 12.1g.

vi. b) Relationship between Hemoglobin status and Average kg Leaves Plucked/ Day as Stated by the Pluckers in the Resurvey in the Study Estate

From Figure 5.11, Pluckers at the Resurvey with Hbs of less than 10g/ dl (N=16) claimed to pluck as much as 27.9kg/ day; those in the range of 10 to 11.9 (N=123) stated they plucked 30.5 kg / day; and those with Hbs of above 12g/ dl, stated that they plucked 32.2 kg tea leaves/ day (The Plucking Average figure were those given just the previous day to the Hb estimations). Although there was a relationship of 'more leaves plucked with higher Hbs', this did not reach a significant level.

vii. a) Percent Shift in Good, Moderate and Poor Pluckers from Baseline to Resurvey in the Study Estate

Figure 5.12, clearly demonstrates the increased and significant shift from Moderate (14-25kg/ worker/ day) to Good Workers (more than 25kg/ worker/ day). The percentage points increased from 33% at Baseline to 49% at Resurvey. The percentage points for Moderate Workers came down correspondingly from 65% to 51%. There were hardly **any** Poor Pluckers (less than 14kg/ day) to start with (1.5%). This also reduced to 0.3%.

This analysis was the most convincing evidence to prove the positive impact of the micronutrient intervention on labour productivity.

vii. b) Impact of the Micronutrient Intervention on Body Mass Index (BMI) of the Pluckers and Non-Pluckers in the Study Estate

Tables 5.21 and **5.22,** depict that a larger percentage of female and male pluckers had a Body Mass Index (BMI) of equally to or greater that 18.5 at the Resurvey than at the Baseline. (37% to 43%). A scrutiny of **Table 5.22**, shows that those with a BMI of more than 18.5, did tend to **pick slightly more** (though not significantly so) than those who had a BMI of less than 18.5.

It was the female non-plucker who did not have to expend so much energy as her plucker counterpart, that showed a highly significant improvement in her BMI, namely, from 42% (Baseline) to 69% at (Resurvey). Overall, the BMI in the total worker population did improve significantly(44% at Baseline to 55% at Resurvey). This was possibly due to a combination of better appetite and the general Nutrition Education given by the Research Team to **eat more**. The Management stated that more **subsidized rice** was being purchased from the Ration Shop !

iii. a) Impact of the Micronutrient Intervention on Common Health Problems in Pluckers and Non-Pluckers as Perceived by them on the Study Estate

Table 5.23 shows that common health problems on the whole were perceived by the Workeforce to have **decreased** from **Baseline** to **Resurvey**. This was found to be highly significant. Perceived decreases were with respect to general weakness (7 to 7%); all aches (body/ head/ neck/ limbs/ joints/ shoulder) from 65% to 7%;

and bronchitis/ URI/ cough etc. (11 to 1%); and obstetrical and gynecological problems (13 to 3%). However complaints of abdominal pain, giddiness and gastritis rose significantly from 7 to 32%. We feel gastritis is a very real problem and may be caused by over-chlorination of the potable water. This needs to be looked into. We cannot explain the perceived rise in abdominal pain and giddiness.

ix. a) Impact of the Micronutrient Intervention on the Perceived Improvements in Health by Regular, Irregular and 'Stopped Taking' Pluckers and Non-Pluckers in the Study Estate

Table 5.24 reveals a clear and significant relationship of positive health perceptions of 'feeling better' among the **Regular Users** of the iron + Vitamin-A supplements (72%). This percentage slid to 37% among the Irregular Users; and still further to 6% among those who had 'Stopped Taking' the supplements.

Overall, 54% claimed to feel better; 9% said their appetite had improved; and 44% perceived no change in their state of health.

x. a) Relationship between Hemoglobin Status and Attendance of Female Pluckers in the Study Estate

Table 5.25 and **Figure 5.13** sets out the relationship between monthly attendance and hemoglobin status, the assumption or hypothesis being that better the Hb status better would be the attendance. Although there was a distinct trend to support this hypothesis, the relationship missed statistical significance.

Section D : Cost effectiveness of the Intervention

This Section will refer to the Pre and During Intervention periods in the Study Estate only.

The cost effectiveness of the Micronutrient Intervention will be discussed under the following heads as under :

⇒ The cost of the multinutrient package consisting of medicinal iron and Vitamin-A supplementation + iodized salt per worker and his/ her family for a period of nine months.

⇒ The cost-effectiveness in terms of total number of Tea-Pluckers employed in the Pre and During Periods of Intervention.

i. The cost of the multinutrient package per worker and family

The cost of 500 tablets of the medicinal iron supplement (60mg elemental iron) for 2 dosing rounds at 250 tablets/ round was Rs.5/-. The cost of 250 capsules of 1600 IU Vitamin-A + 400 IU Vitamin-D for two dosing rounds at 125 tablets/ round was Rs.10/-. The cost of 9, 1kg packets of Captain Cook's iodized salt (30 ppm) for the nine months of intervention at Rs.5.50/ packet x 9 months was Rs.49.50. Since the worker paid Rs.2/ packet, the cost to the Management was Rs. 3.50/ packet x 9 packets or Rs.31.50/-. The cost of the screw -top containers was Rs.15/ container. Hence, the total cost of the micronutrient intervention was **Rs.61.50 per worker and family**.

The cost of the micronutrient intervention for 700 workers (some buffer stocks were calculated), came to **Rs. 43,050.**

A worker and his/ her family generally consisted of the worker, spouse, two children and an elderly dependent or five members. Hence the cost of the micronutrients was **Rs.12.30** per family member.

i. Cost - effectiveness in terms of total number of Tea Pluckers employed in the Pre and During Periods of Intervention

Hundred and four less workers were employed in the nine-months Intervention as compared to the Pre-Intervention. A worker generally works 25 days per month. As per the current Labour Act, the minimum daily wage/ worker per day is Rs.43.

Hence the Management has made a financial saving of 104 workers x Rs.43 daily minimum wage x 25 working days per month or Rs. **1,11,800/-**

Hence the Management more than recovered the actual cost of the three micronutrients which was **Rs. 43,050**.

We are very happy to report that the CEO of the Study Estate decided to continue with the Intervention on the basis of the improved health of the majority of his Work Force and their family members.

Table 5.1

Comparison of Average Rainfall and Rainy Days in the Study and Control Estates in the Pre and During Intervention Periods

Months	STUDY ESTATE				CONTROL ESTATE			
	PRE		DURING		PRE		DURING	
	Rainfall (inches)	Rainy days	Rainfall (inches)	Rainy Days	Rainfall (inches)	Rainy Days	Rainfall (inches)	Rainy Days
Aug	21.53	26	25.97	31	62.70	28	48.41	30
Sept	14.47	14	8.50	20	25.00	13	21.15	15
Oct	3.61	12	4.49	8	10.10	11	16.30	8
Nov	0.91	6	0.57	4	2.06	3	0.20	1
Dec	0.00	0	0.79	4	0.00	0	2.10	3
Jan	0.00	0	0.03	1	0.00	0	0.00	0
Feb	0.00	0	0.00	0	0.00	0	0.00	0
Mar	0.43	2	1.99	3	0.00	0	3.50	3
Apr	2.83	5	2.93	5	8.17	7	8.64	4
Total	**43.78**	**65**	**46.71**	**76**	**108.03**	**62**	**100.3**	**64**

PRE : August 1995 to April 1996
POST : August 1996 to April 1997

Table 5.2

Comparison of Crop Yield in the Pre and During Intervention Periods in the Study and Control Estates

	STUDY		CONTROL	
Months	**PRE (kg/ Hct)**	**DURING (kg/ Hct)**	**PRE (kg/ Hct)**	**DURING (kg/ Hct)**
August	213	193	190	120
September	204	248	178	253
October	241	244	268	200
November	249	237	261	229
December	177	181	170	227
January	112	99	104	91
February	131	119	109	150
March	151	97	122	169
April	190	189	168	169
Total	**1668**	**1607**	**1570**	**1607**

Table 5.3

Comparison of Average Tea Leaves Plucked (kg/ Plucker/ day) in the Pre and During Intervention Periods in the Study and Control Estates

	STUDY		CONTROL	
Months	**PRE**	**DURING**	**PRE**	**DURING**
August	25.7	27.4	29.02	17.33
September	24.8	33.6	20.88	30.05
October	29.2	27.6	28.07	22.11
November	27.7	34.4	24.92	25.16
December	22.4	25.9	19.29	22.87
January	17.3	16.3	13.51	10.71
February	17.6	20.5	14.99	18.06
March	16.1	18.6	12.52	15.71
April	24.8	24.2	19.22	20.54
Average	**22.90**	**25.60***	**20.80**	**20.69**

ndicates that the value of 25.6 was significantly better than 22.9 in the Study Estate $p < 0.001$ level.

ere was no significant difference between 20.80 and 20.69 in the Control Estate.

Table 5.4

Relationship between average kg Leaves plucked and Crop Yield in the Pre and During Intervention periods in the Study Estates

	Correlation coefficient	Significance level
Pre Intervention (Aug 95 to Apr96)	0.8077	0.01
During Intervention (Aug96 to Apr97)	0.9145	0.001

Table 5.5

Impact of the Micronutrient Intervention on the average Leaves Plucked (kg/plucker/day) in the Pre and During Intervention periods in the Study Estate

	Pre Intervention			During Intervention		
	N	Mean	SD	N	Mean	SD
August	327	25.7	5.69	315	27.4 ***	4.66
September	313	24.8	6.75	322	33.6 ***	7.28
October	326	29.2	6.65	315	27.6 **	7.43
November	324	27.7	6.26	321	34.4 ***	6.93
December	326	22.4	5.48	315	25.9 ***	5.65
January	313	17.3	5.47	268	16.3 *	6.28
February	311	17.6	4.45	317	20.5 ***	6.28
March	305	16.1	4.20	288	18.6 ***	4.54
April	322	24.8	5.78	302	24.2 NS	5.88
August to April	2867	22.9	7.26	2763	25.6 ***	8.51

Comparison between Pre and During Intervention periods

*** Significant at $p < 0.001$, ** Significant at $p < 0.01$, * Significant at $p < 0.05$, NS Not Significant

Table 5.6

Impact of the Micronutrient Intervention on the average Leaves Plucked (kg/plucker/day) by the same Pluckers who were present at the Pre and During Intervention periods in the Study Estate

	Pre Intervention			During Intervention		
	N	Mean	SD	N	Mean	SD
August	310	25.9	5.68	310	27.4 ***	4.66
September	304	24.9	6.77	304	34.0 ***	7.23
October	306	29.6	6.45	306	27.7 ***	7.46
November	313	27.8	6.30	313	34.6 ***	6.93
December	305	22.7	5.38	305	26.0 ***	5.68
January	254	17.3	5.76	254	16.4 **	6.26
February	293	17.7	4.46	293	20.8 ***	6.25
March	276	16.2	4.27	276	18.6 ***	4.5?
April	285	25.2	5.63	285	24.3 ***	8.92

omparison between Pre and During Intervention periods

** Significant at $p < 0.001$, ** Significant at $p < 0.01$

Table 5.7

Number of tea pluckers employed per month in the Pre and During Intervention periods in the Study Estate

Month	No. of pluckers employed		
	Pre Intervention	During Intervention	Difference
August	327	315	-12
September	313	322	+9
October	326	315	-11
November	324	321	-3
December	326	315	-11
January	313	268	-45
February	311	317	+6
March	305	288	-17
April	322	302	-20
Total	**2867**	**2763**	**-104**

Table 5.8

Month by month absenteeism among pluckers in the Pre and During Intervention periods in the Study Estate

Months	Pre Intervention (Days)				During Intervention (Days)			
	Work Days	Present	Absent		Work Days	Present	Absent	
			No.	%			No.	%
ıugust	27	20	7	26	27	20	7	26
eptember	26	21	5	19	25	19	6	24
ıctober	26	19	7	27	27	22	5	19
ovember	26	21	5	19	26	19	7	27
ecember	26	20	6	23	27	20	7	26
ınuary	27	17	10	37	27	17	10	37
ebruary	25	17	8	32	24	16	8	33
arch	26	19	7	27	26	18	8	31
pril	26	18	8	31	26	20	6	23
verall	26	19	7	27	26	19	7	27

Table 5.9

Average Leaves Plucked (kg/plucker/day) by the 9 gangs in the Pre and During Intervention periods in the Study Estate

Gang	Pre Intervention			During Intervention		
	N	Mean	SD	N	Mean	SD
1	43	24	4.0	43	27	4.2
2	37	23	5.3	38	25	5.4
3	41	23	5.1	41	25	4.7
4	39	22	5.0	39	25	4.8
5	36	22	3.9	38	25	4.7
6	41	22	4.4	40	25	4.4
7	38	25	4.8	38	27	5.2
8	21	23	3.8	21	25	3.9
9	23	24	3.6	22	26	3.6
Total	319	23	4.6	320	26	4.6

Comparison within Pre and During Intervention periods
Gang effect not significant at $p < 0.05$

Table 5.10

Changes in number of patients who were referred for various nutrition related problems from Estate hospital to other hospitals during the Baseline and Resurvey in the Study Estate

Health Problems	Baseline		Resurvey	
	N	%	N	%
General weakness/aches & pains	31	27	14	16
Loss of appetite	2	2	0	0
GIT problems/Gastritis/Peptic ulcer/Liver problems	21	18	8	9
Respiratory problems	5	4	19	22
Goitre	1	1	0	0
Anemia	1	1	0	0
General checkup	55	47	45	52
Total	116		86 **	
Total decrease	26%			

Comparison between Baseline and Resurvey
** Significant at $p < 0.01$

Table 5.11

Regularity of use of the Micronutrients by the workers as stated by them in the Study Estate

Subjects	Regularity					
	Regular		Irregular		"Stopped Taking"	
	N	%	N	%	N	%
Grand Total	410	58	235	33	62	9
Plucker						
Female	181	54	144	43	10	3
Male	10	71	4	29		
Non-plucker						
Female	22	41	12	22	20	37
Male	132	63	58	28	20	10
Dependants						
Female	5	25	9	45	6	30
Male	3	60			2	40
Children	57	83	8	12	4	6

Regular = Iron tablets taken twice a week
Irregular= Iron tablets taken off & on /once a week
"Stopped Taking" = Stopped after taking for one to two months

Table 5.12

Distribution by the supervisors of the "Information Education Communication" sheet before the Baseline and Resurvey survey in the Study Estate

	Baseline	Resurvey
Sample size	17	19
Sheet		
Distributed (%)	94	95
Explained (%)	94	95
Total	100	100

Table 5.13

Knowledge of the Supervisors and Workers(subsample) regarding the dosing pattern of Micronutrients and their benefits in the Baseline and Resurvey in the Study Estate

	Baseline		Resurvey	
	N	%	N	%
Dosing pattern				
Supervisors				
Known	15	88	18	95
Not known	2	12	1	5
Workers				
Known	98	82	163	99
Not known	21	18	1	1
Benefits				
Supervisors	8	47	18	95
Known	9	53	1	5
Not known				
Workers				
Known	93	78	161	98
Not known	26	22	3	2

Benefits = Intake of iron tablet improves hemoglobin level and physical work capacity, intake of Vitamin A capsule improves vision and reduces frequency of illness, intake of iodized salt improves health and prevents iodine deficiency

Known =Know a minimum of one benefit

Table 5.14

Nutrient intake of the sub sample of the female Pluckers in the Baseline and Resurvey in the Study Estate

	Baseline	Resurvey
Calories (Kcal)		
N	89	94
Mean	1847	1950 *
SD	298	250
%RDA	88	93
Protein (g)		
Mean	38	42 *
SD	7	8
%RDA	76	84
Iron (mg)		
Mean	6.8	11.3 *
SD	1.9	2.3
%RDA		38
Vitamin A (ug)		
Mean	129	165 *
SD	65	38
%RDA	21	27

)A = Calories 2100 kcal (Moderate worker)
Protein 50 gm
Iron 30 mg
Vitamin A 600 ug (Retinol beta carotene x 0.25)
)urce = ICMR 1993)

mparison between Baseline and Resurvey
Significant at $p < 0.05$

Table 5.15

Impact of the Micronutrient Intervention on clinical signs of Iron deficiency in the Pluckers, Non-pluckers and Children in the Study Estate

Prevalence	Baseline		Resurvey	
	N	%	N	%
Plucker				
No sign	190	55	312	89 ***
Any sign	158	45	37	11
Pale Conjuctive	156	45	33	9 ***
Pale Nails	78	22	10	3 ***
Non-plucker				
No sign	141	52	242	92 ***
Any sign	128	48	22	8
Pale Conjuctive	112	42	21	8 ***
Pale Nails	81	30	2	1 ***
Children				
No sign	29	35	55	80 ***
Any sign	55	65	14	20
Total				
No sign	360	51	609	89 ***
Any sign	341	49	73	11

Comparison between Baseline and Resurvey
*** Significant at $p < 0.001$

Table 5.16

Impact of the Micronutrient Intervention on clinical signs of Vitamin A deficiency in the Pluckers, Non-pluckers and Children in the Study Estate

Prevalence	Baseline		Resurvey	
	N	%	N	%
Plucker				
No sign	281	81	335	96 ***
Any sign	67	19	14	4
Night Blindness	32	9	8	2 ***
Conj. Xerosis	29	8	8	2 ***
Bitot's Spot	6	2	3	1 NS
Non-plucker				
No sign	208	77	255	97 ***
Any sign	61	23	9	3
Night Blindness	27	10	5	2 ***
Conj. Xerosis	25	9	3	1 ***
Bitot's Spot	9	3	2	< 1 **
Children				
No sign	79	94	67	97 NS
Any sign	5	6	2	3
Total				
No sign	569	81	657	96 ***
Any sign	133	19	25	4

Comparison between Baseline and Resurvey

***** Significant at p < 0.001, ** Significant at p < 0.01, NS Not Significant**

Table 5.17

mpact of the Micronutrient Intervention on clinical signs of Iodine deficiency in the Pluckers, Non-pluckers and Children in the Study Estate

Prevalence	Baseline		Resurvey	
	N	%	N	%
Plucker				
Present	63	18	36	10 ***
Not present	285	82	313	90
Non-plucker				
Present	55	20	12	5 ***
Not present	214	80	252	95
Children				
Present	0	0	1	1 ***
Not present	84	100	68	99
Total				
Present	118	17	49	7 ***
Not present	583	83	633	93

mparison between Baseline and Resurvey
* Significant at p < 0.001

Table 5.18

Impact of the Micronutrient Intervention on Hemoglobin status of the Pluckers, Non-pluckers and Children in the Study Estate

Subjects	Hemoglobin (g/dl)					
	Baseline			Resurvey		
	N	Mean	SD	N	Mean	SD
Plucker						
Female	334	11.0	.9	334	11.9 ***	1.1
Male	13	12.0	.6	14	13.5 ***	1.3
Non-plucker						
Female	51	10.7	1.3	51	11.6 **	1.8
Male	213	12.1	.9	209	14.0 ***	1.2
Children	83	10.8	1.0	69	11.6	.9
Plucker & Non-plucker						
Female	385	11.0	.9	385	11.9 **	1.2
Male	226	12.1	.9	223	14.0 ***	1.2

omparison between Baseline and Resurvey
** Significant at p < 0.001, ** Significant at p < 0.01

Table 5.19

Impact of the Micronutrient Intervention on Hemoglobin status of the Regular, Irregular and "Stopped Taking" Pluckers and Non-pluckers in the Baseline and Resurvey in the Study Estate

Subjects		Baseline Hb (g/dl)			Resurvey HB (g/dl)		
		Regular	Irregular	"Stopped Taking"	Regular	Irregular	"Stopped Taking"
Plucker							
Female	N	174	135	8	174	135	8
	Mean	11.1	10.9	11.0	12.0 *	11.8 *	11.3
	SD	.8	1.0	1.4	1.0	1.1	1.3
Male	N	9	4		9	4	
	Mean	11.6	1.2		13.6	14.0	
	SD	1.3	.2		.9	1.3	
Non-plucker							
Female	N	18	10	1	18	10	1
	Mean	11.1	10.8	11.0	12.1	10.9	11.1
	SD	1.0	.9		1.2	2.4	2.0
Male	N	118	44	4	118	44	4
	Mean	12.1	12.2	12.3	14.0	14.2	14.2
	SD	.9	.9	.6	1.2	1.1	.5
Plucker and Non-plucker							
Female	N	192	145	9	192	145	9
	Mean	11.1	10.9	11.0	12.0 **	11.7 **	11.4
	SD	.8	.9	1.4	1.0	1.3	1.3
Male	N	127	48	4	127	48	4
	Mean	12.1	12.2	12.3	14.0	14.2	14.2
	SD	.9	.8	.6	1.2	1.1	.5

Regular = Iron tablets taken twice a week
Irregular= Iron tablets taken off & on /once a week
"Stopped Taking" = Stopped after taking for one to two months

Comparison within Baseline and Resurvey
Regular Vs Irregular; Regular Vs "Stopped Taking"; Irregular Vs "Stopped Taking"
** Significant at $p < 0.01$, * Significant at $p < 0.05$

Table 5.20

Impact of the Micronutrient Intervention on average Leaves Plucked (kg/plucker/day) by the Good, Moderate and Poor Pluckers and their Hemoglobin levels in the Study Estate

Pluckers	Pre Intervention		During Intervention	
	Leaves Plucked	Hb	Leaves Plucked	Hb
Good				
N	113	107	166	143
Mean	28.1 ***	11.1	29.3 ***	11.9 ***
SD	2.47	0.91	3.15	1.13
Moderate + Poor				
N	227	227	173	137
Mean	19.9 ***	11.0	21.7 ***	12.1 ***
SD	3.01	0.96	2.49	1.18
Overall				
N	340	308	339	284
Mean	22.6	11.0	25.4 ***	12.0 ***
SD	4.79	0.94	4.74	1.16

Good plucker: More than 25 kg leaves plucked per day
Moderate plucker: 14 to 25 kg leaves plucked per day
Poor plucker: Less than 14 kg leaves plucked per day

Cpmparisons within Pre and During Intervention periods
Good Vs Moderate+Poor. kg leaves plucked; Hb levels

Comparisons between Pre and During Intervention periods. kg leaves plucked; Hb levels

*** Significant at $p < 0.001$

Table 5.21

Impact of the Micronutrient Intervention on Body Mass Index (BMI) of the Pluckers and Non-pluckers in the Study Estate

Nutritional Status	Baseline		Resurvey	
	N	%	N	%
Plucker				
Female				
BMI >= 18.5	122	37	140	42
BMI < 18.5	212	63	195	58
Male				
BMI >= 18.5	7	50	10	71
BMI < 18.5	7	50	4	29
Total				
BMI >= 18.5	129	37	150	43
BMI < 18.5	219	63	199	57
Non-plucker				
Female				
BMI >= 18.5	22	42	37	69 **
BMI < 18.5	30	58	17	31
Male				
BMI >= 18.5	97	45	107	51
BMI < 18.5	120	55	103	49
Total				
BMI >= 18.5	119	44	144	55 *
BMI < 18.5	150	56	120	45

Comparison between Baseline and Resurvey

**** Significant at p < 0.01, * Significant at p < 0.05**

Table 5.22

Impact of the Micronutrient Intervention on average Leaves plucked (kg/plucker/day) by female pluckers in relation to their Body Mass Index (BMI) in the Study Estate

BMI	Pre Intervention	During Intervention
>= 18.5		
N	113	123
Mean	23.0	25.9
SD	4.80	4.59
< 18.5		
N	227	216
Mean	22.5	25.2
SD	4.79	4.82

Comparison between Baseline and Resurvey

Relationship within intervention period not significant at p < 0.05

Table 5.23

Impact of the Micronutrient Intervention on common Health problems in Pluckers and Non-pluckers as perceived by them in the Study Estate

Health Problems	Baseline (N=617)		Resurvey (N=613)	
	N	%	N	%
Present	543	88	333	54 ***
Not present	74	12	280	46
General weakness	104	17	44	7 ***
All aches/pains (Body, head, neck, limbs, joint. shoulder)	400	65	82	13 ***
Bronchitis, URI, cough & congestion	66	11	8	1 ***
Abdominal pain, giddiness, gastritis	43	7	195	32 ***
Obstetrical & gynaecological problems(Female)	81	13	20	3 ***

Comparison between Baseline and Resurvey

*** **Significant at p < 0.001**

Table 5.24

Impact of the Micronutrient Intervention on the perceived improvement in health by Regular, Irregular and "Stopped Taking" Pluckers and Non-pluckers in the Study Estate

Health perception	Regularity						Total (N=613)	
	Regular (N=345)		Irregular (N=218)		"Stopped Taking" (N=50)			
	N	%	N	%	N	%	N	%
Feel better	248	72	80	37	3	6	331	54
Improoved appetite	41	12	16	7	1	2	58	9
No change	94	27	128	59	47	94	269	44

Regular = Iron tablets taken twice a week
Irregular = Iron tablets taken off & on /once a week
'Stopped Taking" after taking for one to two months

Relationship between Regularity and Health Perception significant at $p < 0.05$

Table 5.25

Impact of the Micronutrient Intervention on Attendance of female Pluckers in relation to their hemoglobin status in the Study Estate

Hemoglobin status (g/dl)	Attendance <= 20 days		Attendance > 20 days	
	N	%	N	%
< 10	8	57	6	43
10 to 11.9	58	52	53	48
12 and above	80	44	100	56

Comparisons within attendance
Relatioship not significant at p 0.05

Figure 5.1

Month by month comparison of Crop Yield
in the Pre and During Intervention(I) periods
in the Study and Control Estates(E)

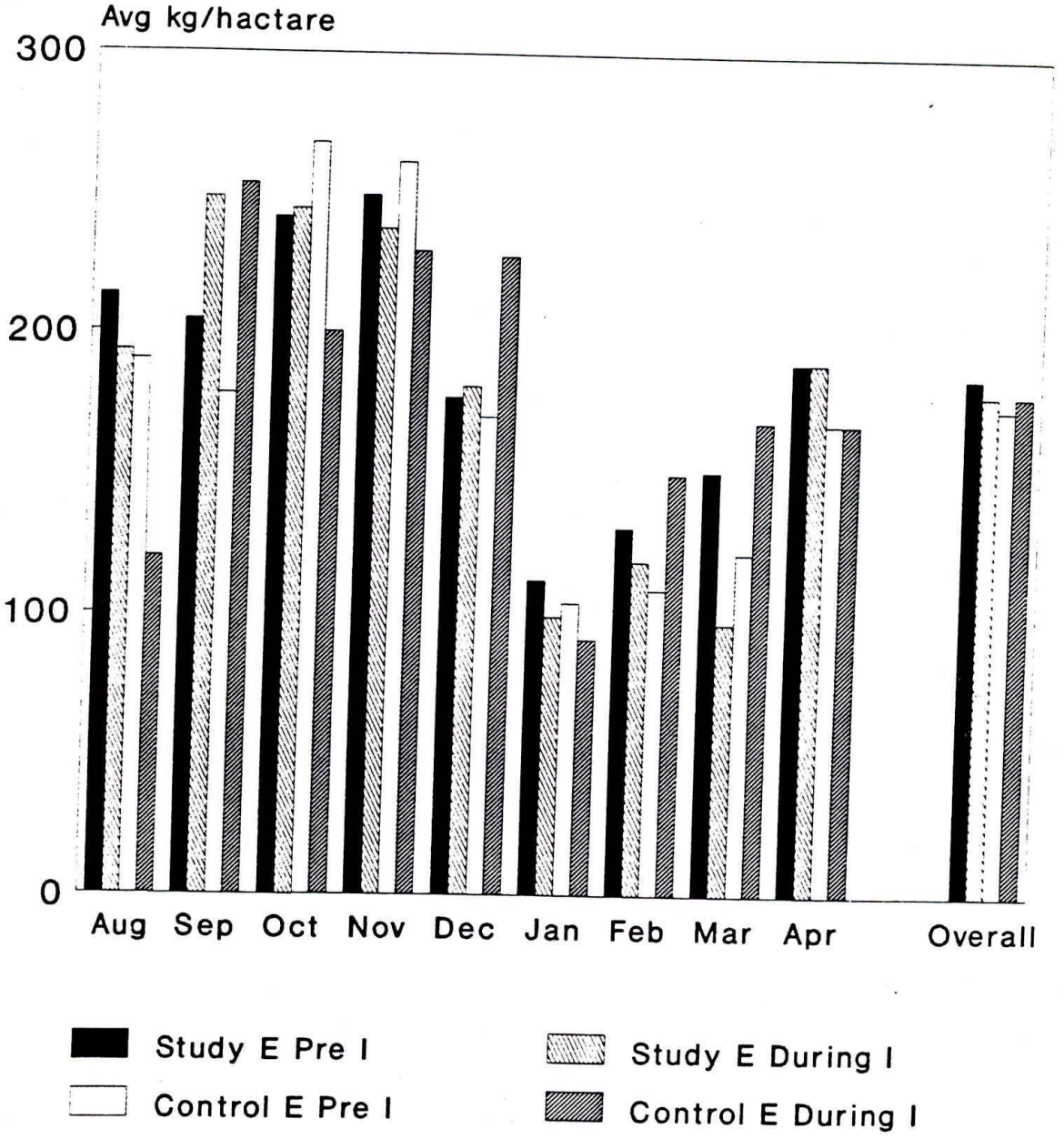


Figure 5.2

Month by month average kg leaves plucked/day per plucker in the Pre and During Intervention(I) periods in the Study and Control Estates(E)

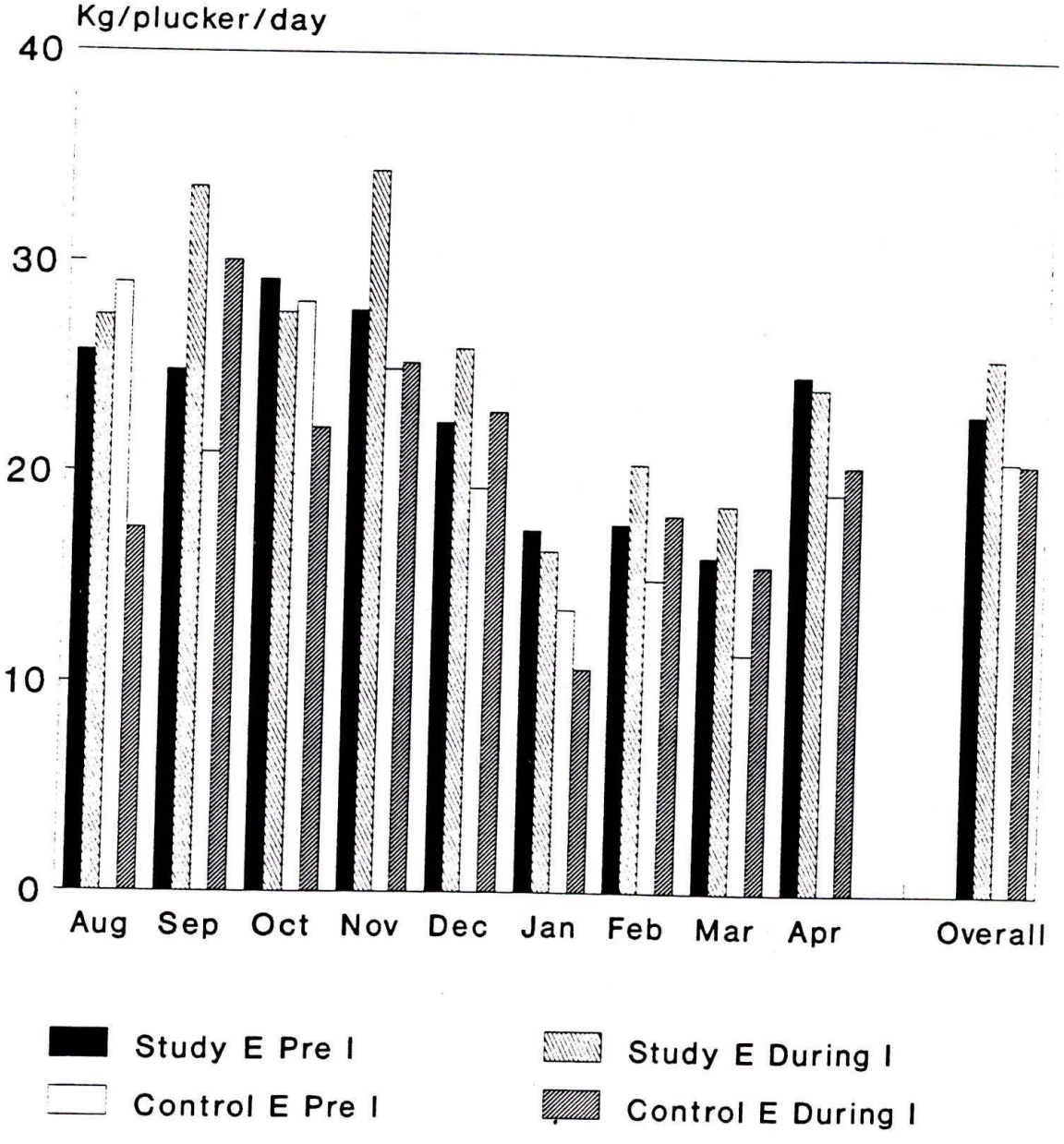
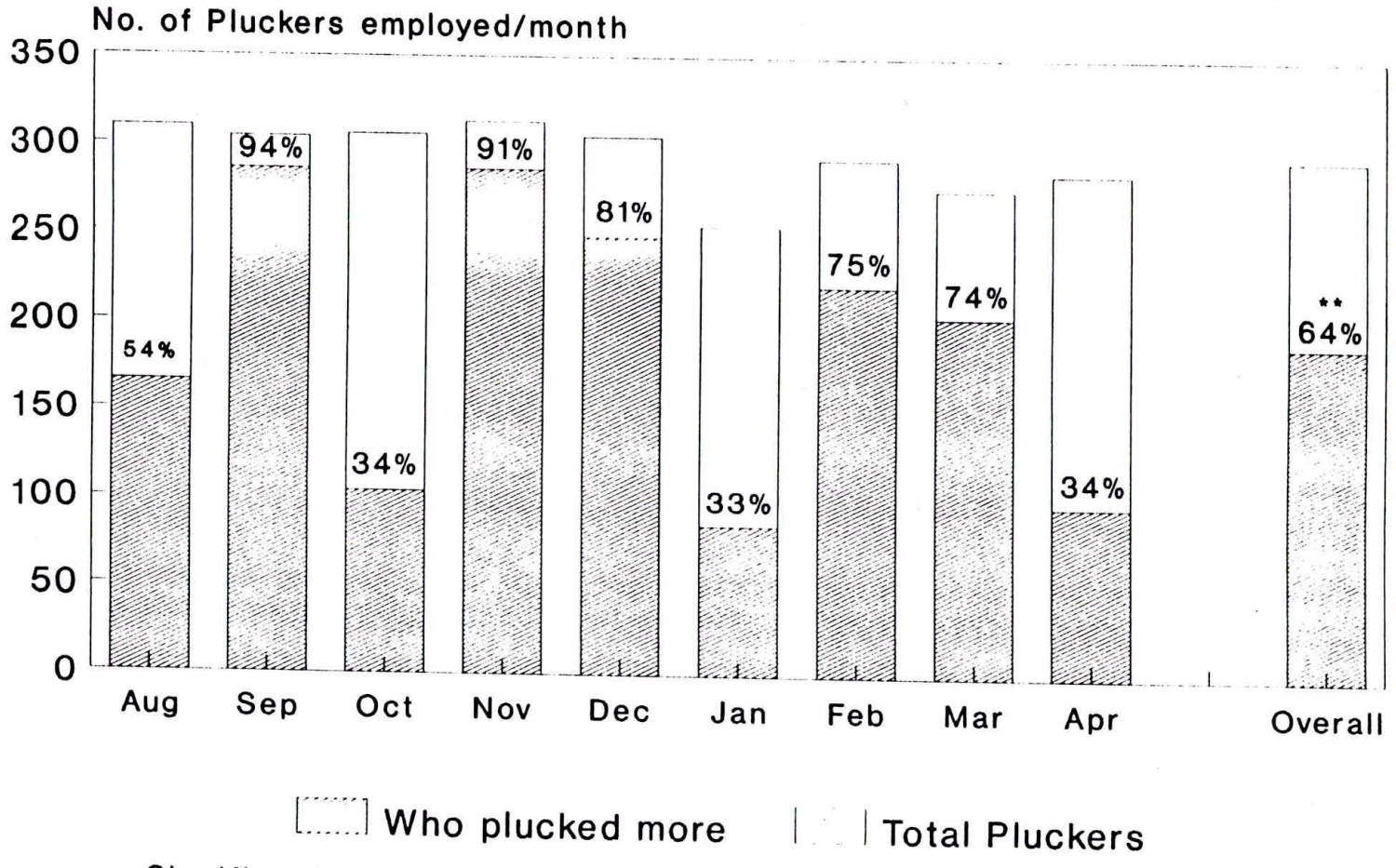


Figure 3.3

Percent Pluckers who plucked more in the During Vs Pre Intervention period in the Study Estate



** Significant at p < 0.01

Figure 5.4

Month by month no. of pluckers employed in the Pre and During Intervention periods in the Study Estate

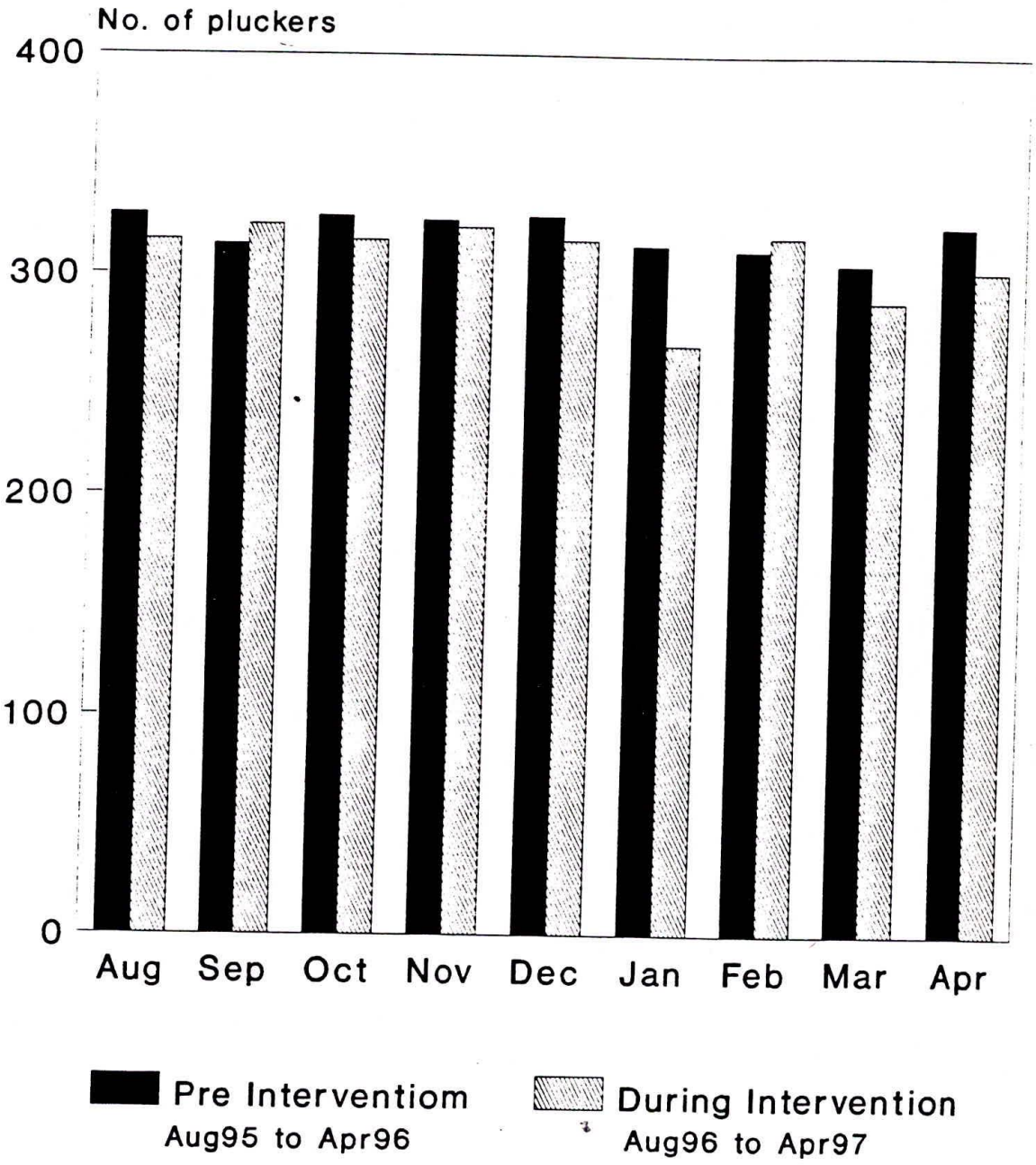


Figure 5.5

Month by month percent days absent by pluckers in the Pre and During Intervention periods in the Study Estate

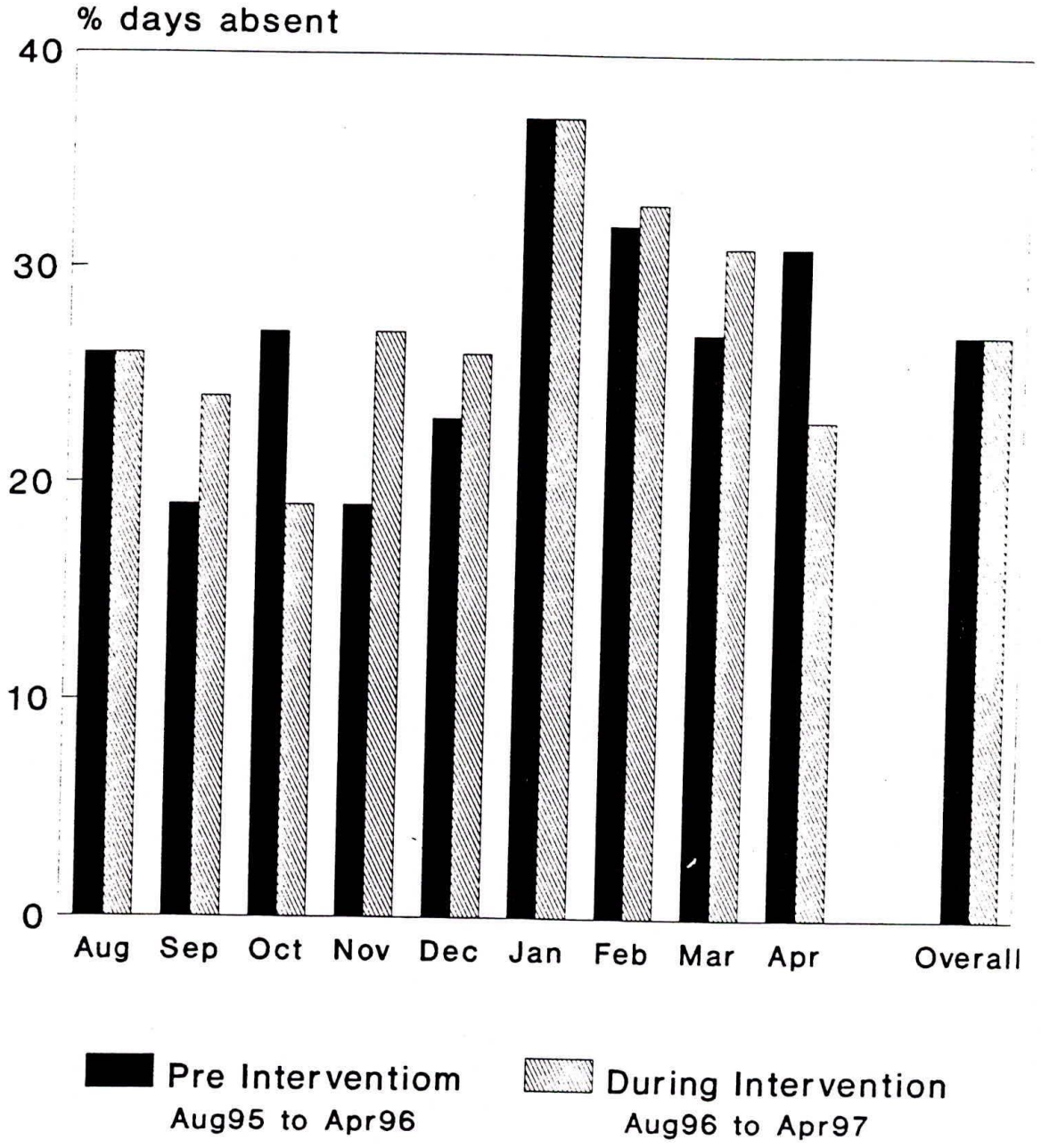


Figure 5.6

Knowledge of the Supervisors(S) and Workers(W) (sub sample) regarding the dosing pattern of the Micronutrients & their benfits in the Study Estates

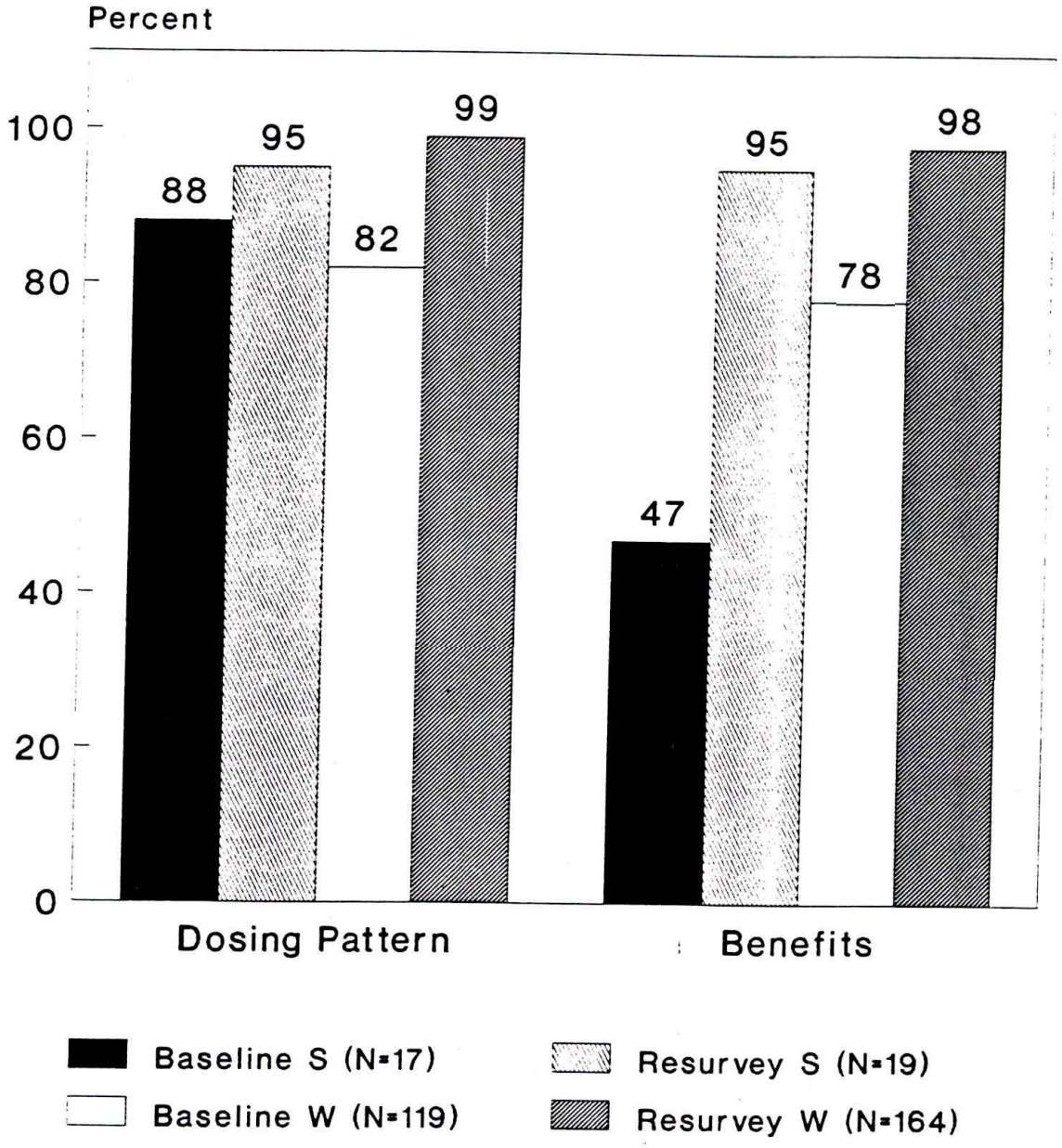
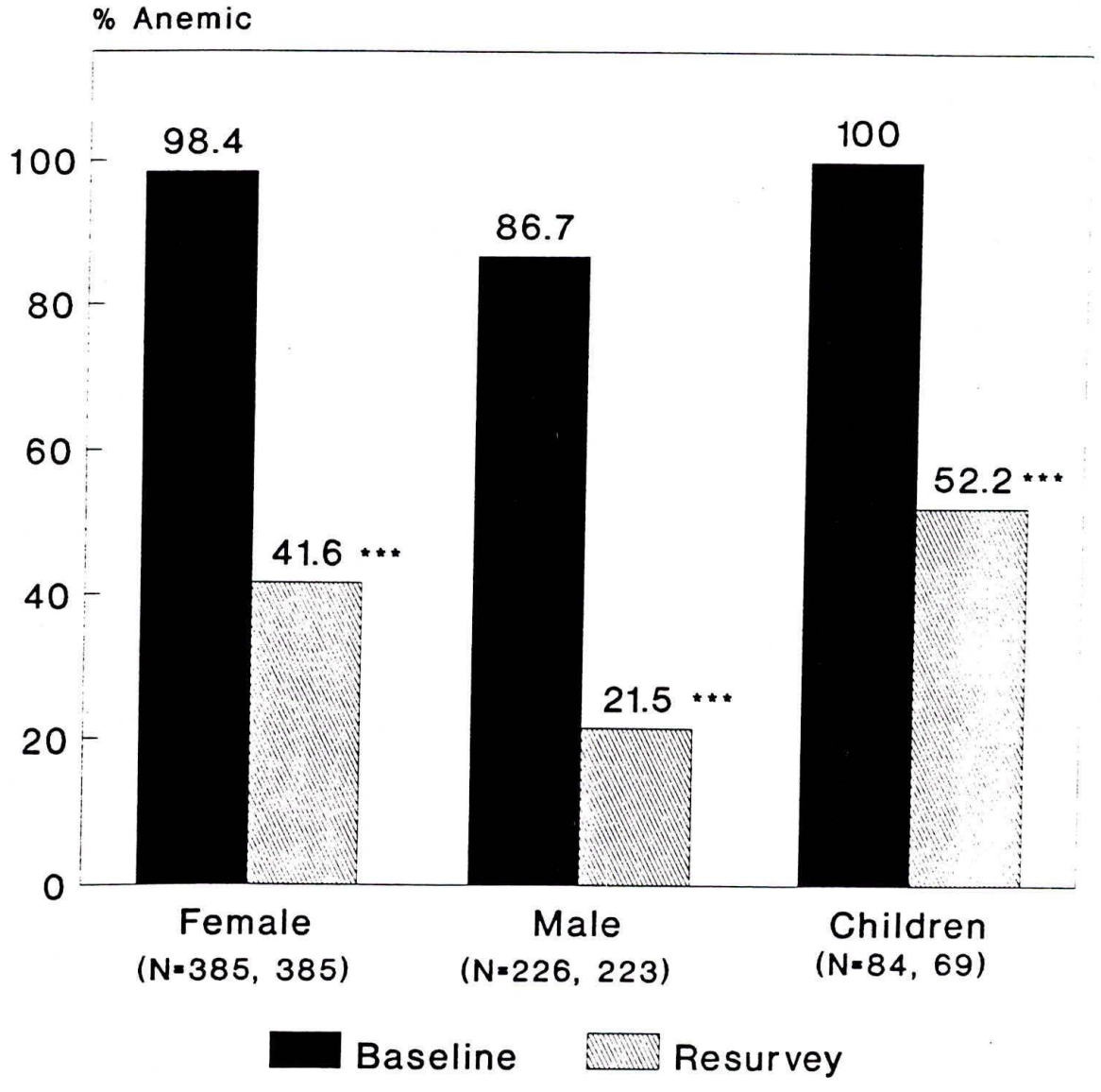


Figure 5.7

Impact of the Micronutrient Intervention as indicated by reduction in Anemia in Female, Male Pluckers and Non-pluckers and their children in the Baseline and Resurvey in the Study Estate



Anemia = Hb<12g/dl in Female and Children
Hb<13g/dl in Male (DeMaeyer 1989)
Comparisons between Baseline and Resurvey
*** Significant at $p < 0.001$

Figures 5.8 to 5.10

Impact of the Micronutrient Intervention on shift in the hemoglobin status distribution curve in Pluckers, Non-pluckers and children in the Study Estate

Figure 5.1 - Female Pluckers and Non-pluckers

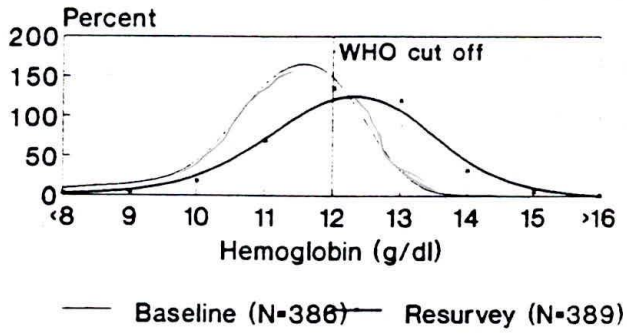


Figure 5.2 Male Pluckers and Non-pluckers

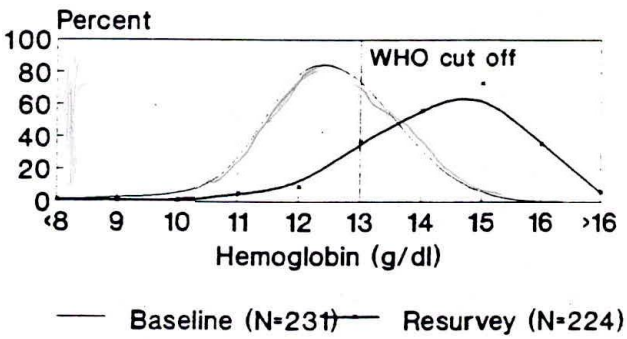


Figure 5.3 Children

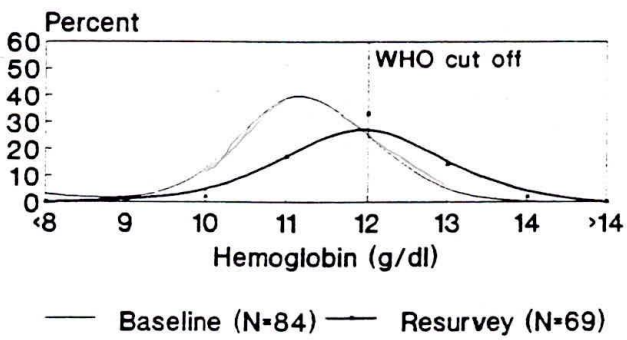
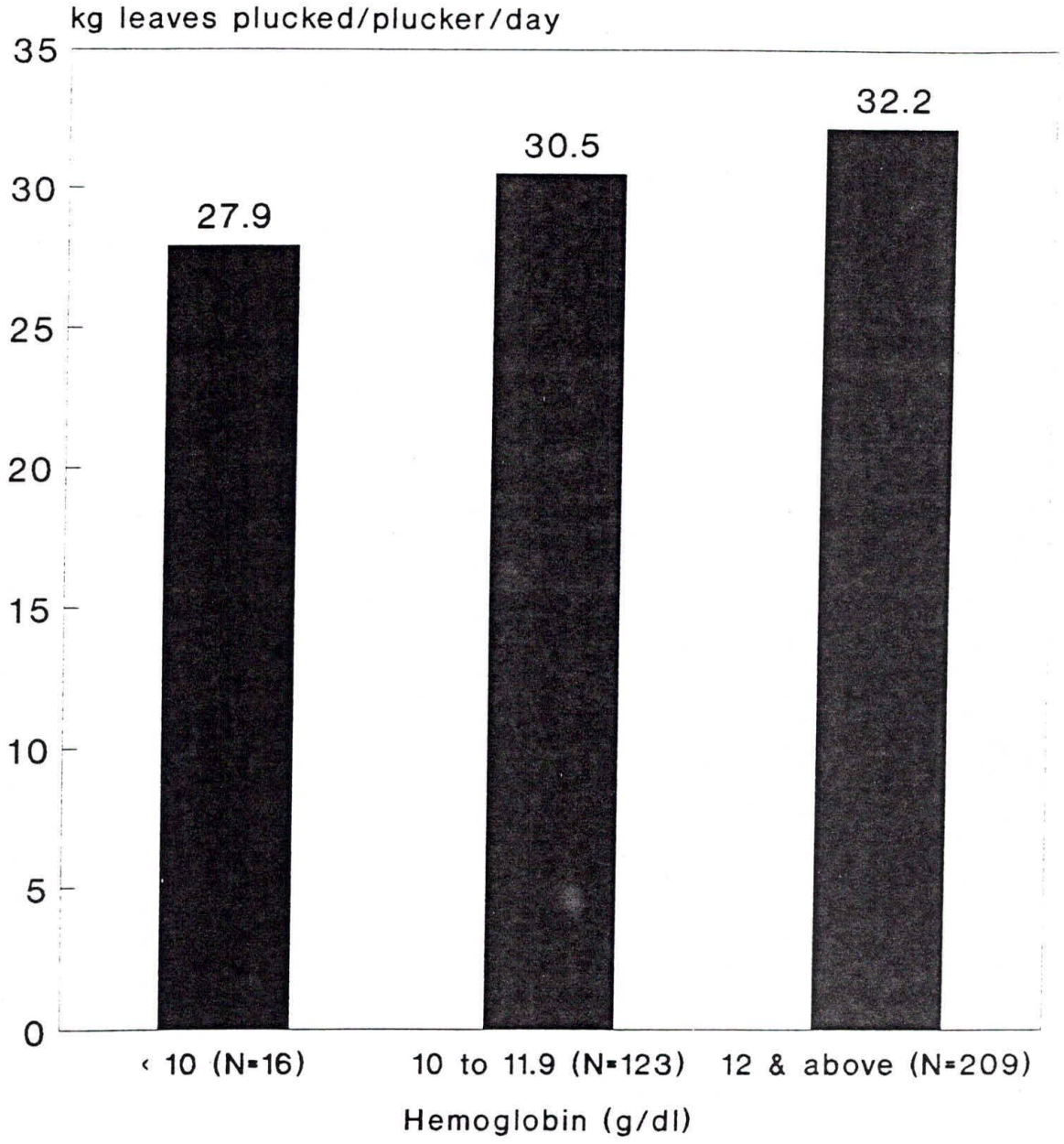


Figure 5.11

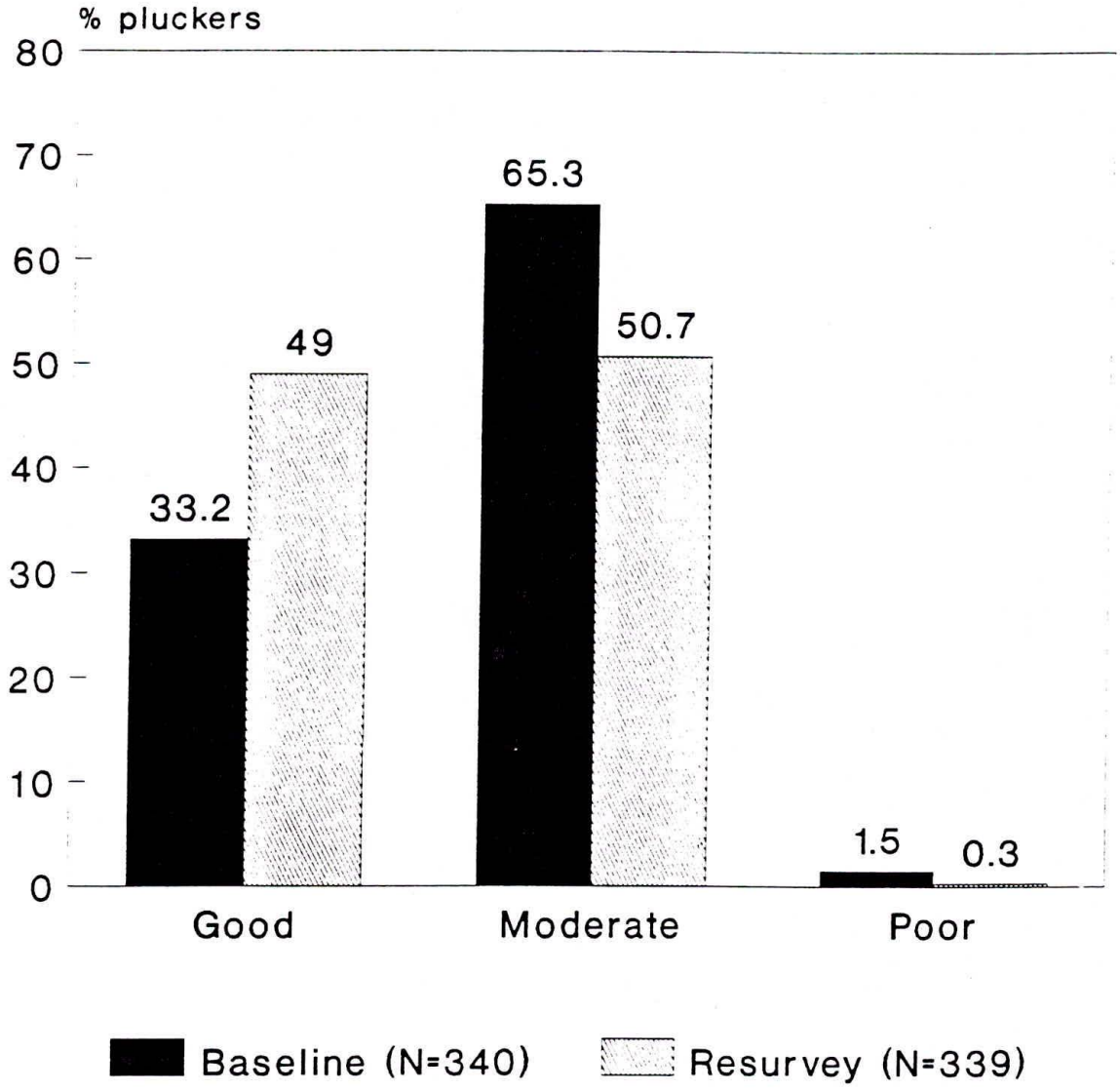
Relatioship between Hemoglobin status and average kg leaves plucked/plucker/day (as stated by them) in the Resurvey in the Study Estate



Relationship not significant at 0.05

Figure 5.12

Perecnt shift in Good, Moderate and Poor pluckers from Baseline to Resurvey in the Study Estate

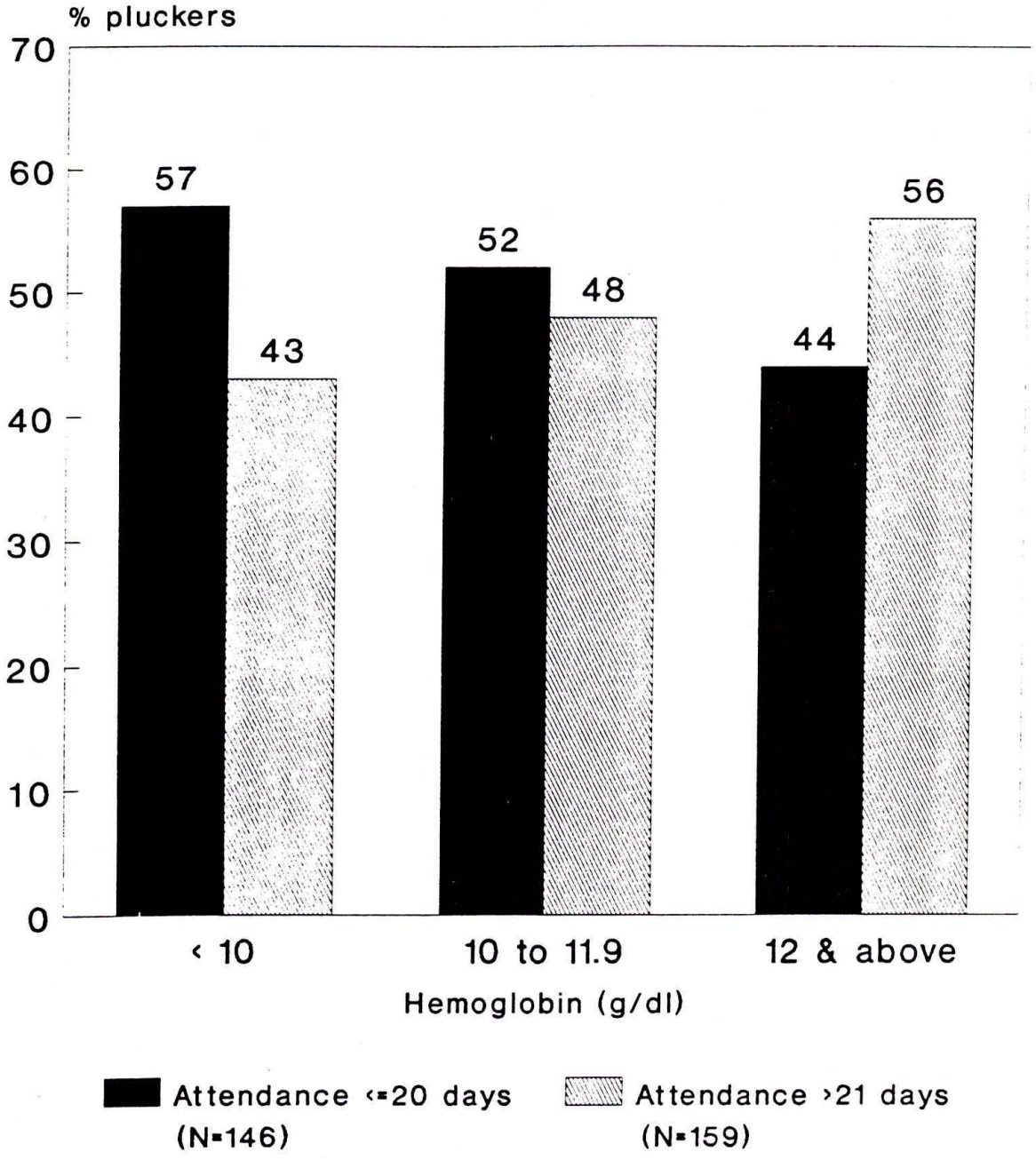


Good : › 25kg leaves plucked/day
Moderate : 14-25kg leaves plucked/day
Poor : ‹ 14 kg leaves plucked per day

Shift significant at ~~0.05~~ $p < 0.001$

Figure 5.13

Relatioship between Hemoglobin status and Attendance of female pluckers in the Study Estate



Relationship not significant at 0.05

Chapter Six - Discussion

Hidden Hunger for iron, iodine and Vitamin-A :

The reduction or the removal of the "Hidden Hunger' for iron, iodine and Vitamin-A among the underprivileged populations of the developing world has engaged the attention of public health professionals and Governments the world over **(23).** There is proof from tea plantation-based studies in India **(3)**; Indonesia **(22);** and Sri Lanka **(7)** that physical work capacity and hemoglobin levels are significantly related. However, the transfer of the findings of these classical studies of the late seventies/ early eighties to the plantations has not had the spread effect it should have.

The Importance of Demonstration Projects

This Demonstration cum Research Action Study was an attempt to partner and work closely with a Tea Plantation in South India and to evaluate whether the **health, productivity** and if possible the **profitability** of the Plantation increased as a result of delivering **all the three micronutrients of 'iron, iodine and Vitamin-A' together, to the entire work force and families** of the Tea Plantation, using the Plantation's own infrastructure and **on-going Management-Information-Systems**. Therefore, the success of this study is to be judged as much or more, by its **Participatory Plan of Action**, its **Development** and its **Implementation** as by the **Impact** achieved as a result of the Micronutrient Intervention.

Improved Health of the Plantation Workforce, especially the Female Pluckers

The Tea Plantation Industry has some unique characteristics which can be capitalized upon in the delivery of the micronutrient package (iron, iodine and Vitamin-A) to its Workforce. The Tea Pluckers are almost always women (24) and skilled pluckers are becoming a rare commodity. Forty to fifty percent of the field operational costs of tea-production can be accounted for by the "plucking of leaves process". Therefore, it makes good sense to devise and assess an intervention or strategy that is simple, acceptable and sustainable.

Was the Micronutrient Intervention simple, acceptable and sustainable ?

Chickmagalur District is an endemic district for Iodine Deficiency Disorders (IDD). Most Low Income Groups(LIGs) manifest high prevalence of Iron Deficiency Anemia(IDA) and Vitamin-A Deficiency (VAD) as well. A recent Karnataka Nutrition Profile of women, adolescent girls and children confirmed that the hidden hunger for iron, iodine and Vitamin-A was indeed widely prevalent in Chickmagalur District **(9)** where our Study Estate was located. Our previous experience in advising the Government of Gujarat (GOG) Western India, had shown that it was possible for the **GOG** to successfully procure and distribute the above micronutrients along with albendazole (anthelmentic) for nearly three million schoolers in every district of Gujarat on an continuing basis **(10).** Hence, we knew that it would be not be difficult to devise a similar and much needed Intervention for the Plantation Workforce. An **uninterrupted supply line** is essential for **any intervention.** Fortunately, ferrous sulphate and iodized salt were in abundant supply - though Vitamin-A was **not**. Double fortified salt (iron + iodine) was our first choice - but a Madras-based supplier was not able to even meet our small order of about 1000 x 1kg packets of double fortified salt every six months. In Gujarat, the cost of albendazole + iron + Vitamin-A came to just Rs.10.50/ school child per year **(10).** In this intervention, the cost of the three micronutrients was just about Rs.12/ person/ year. Provided there is a well **established conduit** to deliver the micronutrients, such as the Plantation Hospital for the medicinal supplements; and the Plantation Ration Shop to stock the iodized salt, **supplementation** or **fortification** is by far the most **easily managed, cheap** and **accountable** of nutrition interventions **(25).** The whole purpose of this Demonstration cum Research Action Project was to jointly design and implement an intervention that was **fully acceptable** to the Plantation Management and Workforce. It has been the experience of many well-intentioned national and international projects, that not sufficient importance is given to the community, its leaders, or the local implementing researchers in operational project design. Very often the project ends with the exit of its research team ! **(26)** In this project, maximum emphasis was to evolve a strategy/ intervention that this Study Plantation **now**, and other surrounding ones in the near future - could and would adopt **willingly**. The CEO of the Study Plantation and his Management on the Plantation have **continued with the micro-nutrient intervention,** even after we the research team (TCS) has exited in April, 1997. We believe that this was possible due to : (i) The **simplicity** of the intervention; (ii) Its **high acceptability** with the Management and Workforce and

(iii) its **sustainability** as it was cost-effective, and the micronutrient inputs were easily available in the market.

Did the Health of the Workforce Improve ?

Very significant micronutrient-specific-improvement in the health of the Workforce (Pluckers and non-Pluckers) and their dependents was observed. The clinical signs of iron, iodine and Vitamin-A deficiency declined. At the Baseline Survey, the Workforce as a whole either had **no IDA** or suffered **from mild IDA**. The mean Hb level of the Woman Pluckers was 11g/ dl and this went up by a gram due to the Intervention. In the men workers the mean Hb level was 12g/ dl which went to 14g/ dl. Hence, the Intervention **did improve** the iron status of the Workforce. Referral to big hospitals for nutrition and the micronutrient-related health problems did decrease significantly. Above all, the majority of the Workforce stated that they 'felt better', 'ate more'and 'felt less tired'. Perception is almost as potent as the real thing. The intervention created a resovoir of good will and a feeling of being cared for. The improved health of the Workforce permeated to the Management as well. The Research Team (TCS) heard many Workers state this was the first-time **all** of them and their families were being given a Health check-up in the Plantation Hospital, even when they were well.

Did the Productivity of the Pluckers Improve ?

The second objective was to see whether the Intervention increased labour productivity as measured by increases in Average Tea Plucked ? The answer is a **very definite 'yes'**. Two types of controls were employed. The first was the Pre-intervention period of August 1995 to April 1996 (9 months) which served as an internal Control to the Experimental Intervention Period of 9 months (August 1996 to April 1997) in the Study Estate. We also had an External Control in a carefully matched nearby Estate which has been referred to in the body of the report as our Control Estate. The Study and Control Estates matched beautifully on the Key characteristic of Average Crop Yield (kg/ Hectare). Our results showed that the Average Tea Plucked (kg/ worker/ day) was significantly higher than in the Internal Control of the Pre-Intervention Period. It was also significantly higher in the intervention period as compared to the External Control Estate over the same intervention period of August 1996 to April 1997.

The significant increase was supported by the fact that the mean Hb levels of the women Pluckers had **also gone up** from 11g/ dl (Baseline) to 11.9g/ dl at Resurvey. The overall health and well being of the Pluckers had improved. Their Body Mass

Index (BMI) had improved; their dietary and nutrient intake had improved; they had fewer micro-nutrient related health problems; the attendance of pluckers who had Hb levels of more than 12g/ dl had better monthly attendance (more than 21 days); they plucked nearly 30kg leaves/ day versus significantly less by those pluckers whose Hb levels were between 10g - 11g/ dl (at Resurvey); they had less health problems that those with lower Hb levels.

There were some major differences in the design and implementation of our study and those done by other investigators on Plantations. Rahamutullah's Indian Study was done some 20 years prior to ours and was conducted in Kerala, South India. The subjects of her study were very anemic (Hb of 6.2g/ dl by the Sahli's method, which is not accepted now) The Pluckers had an Average Plucking Rate of 17kg/ worker/ day. The major objective of her double-blind study was to evaluate the impact of iron, on Hb status and increased work performance and monthly attendance. Iron supplementation was 65mg elemental iron given continuously at the worksite for 100 days. The conclusions of this 6-months-study were that : Mean Hb levels rose from 6.2g to 8.5g/ dl; Average Plucking Rates rose from 17kg to 22kg/ worker/ day; the monthly attendance rose from 19 days to 22 days. The author sums up that human relations between workers improved, absenteeism due to fatigue decreased and potentially good pluckers plucked even more. Pluckers with low Hb levels were not necessarily poor pluckers. Also exceedingly high plucking rates were achieved by the erratic plucker - perhaps driven by other considerations **(3).**

An Indian study in 1987 on IDA and Farm women, clearly indicated that iron supplementation conserved energy and work output was significantly increased after supplementation **(27).** A recent study in China, in 1994 on the functional consequences of iron supplementation in iron-deficient female cotton mill workers, also corroborated the Indian study by concluding that iron supplementation enabled these women to do the same work at a lower energy cost **(28).**

A study in Bombay on the effect of ferrous fumarate on the iron status and physical work capacity(PWC) of women concluded that even middle class Maharashtrian women suffering from mild to moderate iron deficiency anemia showed significant benefits in PWC and increased Hb levels**(29).**

Edgerton etal in a Sri Lankan study on IDA and its effect on worker productivy and activity patterns among female tea pluckers also established the significant relationship between iron supplementation and work capacity. The impact evaluation was done after two months (entire duration of the study). The

investigators reported that work productivity was improved in subjects even with moderate iron-deficiency (Hb levels of 11g/ dl). Subjects with lower Hb concentrations initially experienced the greatest increase in productivity**(7).**

Husaini and co-workers in an evaluation of nutritional anemia intervention among anemic female workers on a tea-plantation in Indonesia, compared the impact of iron-fortified salt (1.5mg Fe/ g salt) or iron supplemented group (60mg elemental Fe/ worker/ day) for four months. Both groups were dewormed as well. The Control group received a plaacebo. They reported that there was a significant relationship between iron supplementation, enhanced Hb status, and enhanced average tea plucked. Direct iron supplementation brought up Hb levels much faster than did iron fortified salt **(22).** The relationship between Hb concentration and PWC has been established on agricultural labour in Gautemala**(30);** in the Philippines **(31);** in Africa **(32);** and in Indonesia **(22).**

All these studies were exploratory in nature with the basic objective of examining the relationship between hemoglobin status and Physical Work Capacity (PWC). They were usually controlled, double-blind and of short duration (generally 2-4 months). The sample size of subjects was generally small. Hence, they cannot be compared with our study. Our study was designed to be Demonstration cum Research Action. Our study had the longest reported intervention period of nine months, which took in the seasonality in crop yield. We delivered a triple micronutrient package of iron + iodine + Vitamin-A. What we did in this study was to move forward and attempt to **empower** a Tea Plantation to **implement** and **manage** their own micronutrient program for their workforce.

We cuncurrently evaluated the impact of the "iron + iodine + Vitamin A" micronutrient intervention on the health of the entire workforce and their families ; the worker productivity of the Female Tea Pluckers; and the Profitability to the Plantation Management.

Did Profitability Increase ?

Our third objective was an attempt to improve profitability. This was a bit over optimistic and ambitious on our part. However, we can say with certainty that the cost of the 'three-in-one micronutrient' intervention was extremely cheap at **Rs.61.50/-**(about USD 1.50) per worker + family per annum. The annual cost per individual (assuming that there were five individuals/ family) was just **Rs.12 (or 30 US cents).** Basta etal had quoted a figure of USD 50 cents for supplementation with 100mg elemental iron per day for 60 days/ man year in the seventies **(4).**

We do not know if there were other managerial considerations, but our data show that **104** less pluckers were employed to pluck more tea leaves in the During Intervention Period Vs the corresponding Pre-Period (even though the crop-yield was the same). This translates to a substantial saving in wages of a little more that **Rs. one lakh.** The total cost of the micronutrients for this intervention was **Rs.43,050.** Hence, if nothing else, the Management more than recovered the money and time spent in implementing and managing this Intervention.

Other Considerations :

The Influence of Crop Yield, Seasons :

The influence of rainfall and season is of paramount and significant importance in the average tea plucked/ worker/ day. Since, our Intervention ran for a duration of nine-months, we were able to assess this for ourselves. We now regret we did not continue our observations for a whole year. A review of the literature shows that even Rahamutullah's impact study was of 6 months duration though data of tea plucked is available for a year. We are surprised that Rahamutallah did not notice from her own data, that the average tea plucked from March to September was noticebly higher than the other months of the year**(3).** This was followed by the study of Husaini etal, whose intervention lasted four months. All the other studies were just of 2 months duration. The effect of season and crop yield appears to have been discounted **(4,7).** Although the Sri Lankan impact study of Edgerton etal was only of two months duration in the drought months, they have also presented data of average tea plucked for a whole year. It is very apparent from their data presented that the average tea plucked in all the four divisions of the Estate were relatively high in the months of February to August. The 'plucking rate' went down sharply from June to September and started limping back in October, November and December. The answer is simple. The monsoons and rainfall influence the crop yield which in turn influence average tea plucked. We feel that the most accurate comparisons should be made on **matched data of Pluckers, month by month** for a Pre and During situation **over one full year.** The month by month crop yield will also have to be compared and controlled for. In spite of this if the intervention (such as ours) had a significant impact, one can conclude with a strong degree of confidence that it was a **true and not chance effect**.

The Effect of a Multinutrient Package Vs a Single Micronutrient :

Multinutrient interventions ride very comfortably and cost-effectively on on-going-programs **(10).** Studies are available which clearly show the positive effect of

Vitamin-A on iron status **(33,34,35).** Whenever and where ever possible it would make good sense to deliver a 'three-in-one-package' of iron, iodine and Vitamin-A at the very least.

The Inclusion of Anthelmentics with the Micronutrient Package :

Again there is abundant evidence that mass-deworming of entire Plantation populations would not only control intestinal helminthic infections, but would bring about much better utilization of the micronutrients **(10,36,37,38).** We are happy to say that this is being done on the Study Plantation from April 1997.

Weekly versus Bi-weekly supplementation with Iron :

This study has shown that two times a week iron supplementation or once a week iron supplementation worked just as well. Again there is ample evidence that weekly iron supplementation is as effective as daily supplementation **(11,12,13).** A strategy that advocates by-weekly or weekly iron supplementation, particularly in institutions such as schools, colleges or even sectors such as industry or agriculture is sure to be much more acceptable to **any** target population.

Importance of Empowering the Target Population to be responsible for their own Micronutrient Health

Finally one has to **empower** an underprivileged community to take care of itself. One **cannot** be policing regular intake. This study showed that by and large the Workforce were responsible about self-dosing, especially so with regard to their children.

Chapter Seven - Recommendations

The following recommendations are based on the findings of this Demonstration cum Research-Action project, which conclusively demonstrated that the **micronutrient (iron, iodine and Vitamin-A) health** of the Plantation Workforce and the **Labour Productivity** (of the **pluckers**) had improved **significantly**.

They are as under :

i. Encourage partnerships between the Management of Plantations, academia/ researchers , and the pharmaceutical/ food processing industry to design and deliver simple, cost-effective and sustainable micronutrient interventions of iron, iodine and Vitamin-A for the Workforce on Plantations.

ii. Build **confidence** and **capacity** among the Management/ staff of Plantations to manage micronutrient interventions on their own.

iii. Demonstrate how **combined** multinutrient interventions can be **easily integrated** into the ongoing health programmes or activities on the Plantation.

iv. Encourage and enthuse the Management, Medical and Health staff to strongly support **Preventive Health Programs**.

v. Encourage Plantation Ration shops to only **procure** and store **reputed brands of iodized salt** and to sell it at **subsidized rates**. Fortification of common foods is the cheapest and simplest way of ensuring that the three micronutrients, namely, **iron, iodine and Vitamin-A** are consumed by the entire Workforce and their families. In the future, the Plantation Management should seriously think of procuring **double fortified salt (iron + iodine)** and selling it to their Workforce at subsidized rates.Cooking oil, likewise can be fortified with **Vitamin A, D and E.**

vi. Convince Apex bodies such as the United Planters of South India to make it **mandatory** to include Micronutrient Interventions into the Comprehensive Labour Welfare Schemes (CLAWS).

vii. Convince the Managers that the improvement of the **health** and **well being** of their Workforce through Micronutrient Interventions, will result not only in better

worker productivity but also in more **cordial relations** between the Management and Workforce.

viii. Spearhead a movement in the Plantation Industry to replicate the Study Estate's success story.

ix. In the spirit of each one teach one, we request the Study Estate to become the preceptor and demonstrator of the above Micronutrient Intervention to not one, but **all** the plantations in Chikmagalur district.

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About Tara Consultancy Services (TCS)

TCS is a technical NGO in public health nutrition. It was established in end 1992 by Professor Tara Gopaldas, former Dean Faculty of Home Science, M.S.University, Baroda; and the Chair of the University department of Foods and Nutrition in the Faculty. TCS has vast research and administrative experience in Programme-Driven-Research in the areas of Food, Nutrition and Health. It has experience in Research Design, Policy and Programme Planning, Implementation, Training, Monitoring and Evaluation. It has the capability to do Operational Research in any area of Human Resource Development, Social Market Research, Participatory Research Assessment, and Cost-Effectiveness analyses are high on its agenda.

TCS has executed seven research projects or consultations since end 1992. They are :

1. A Workshop for Key Influencers on "The imperative need to integrate deworming and micronutrient interventions into the National Mid-Day-Meals-Programme (MDMP)," **1996.** The funder was SmithKline Beecham Pharmaceuticals (India) Ltd.
2. A Demonstration cum Research Action project on "A multinutrient package for tea plantation workers for better health, productivity and profitability". **1996-1998.** The funder was USAID-OMNI-ILSI for global research projects.
3. The research design for an All-India-Survey for the National Assessment and Accreditation Council (NAAC) of India on "What are the perceptions of quality in higher education by the stake holders, namely, the students, parents and employers?" **1997.** The funder was NAAC.
4. As the India Partner of the Partnership for Child Development (PCD), Oxford University, UK, TCS conducted "The pre-post impact evaluation of the improved Mid-Day-Meals-Programme, Gujarat" **1993-1996.** The funder was the Rockfeller Foundation for Health Sciences, USA - through PCD.
5. An appraisal report on Weaning Technology for the Government of India. **1994.**
6. Honorary Adviser on the MDMP, Gujarat to the Government of Gujarat **(1992-1993).**
7. Adviser to UNICEF and the Government of Rajasthan on "The improvement of the nutrition component for the 'Below Threes' in the Integrated Child Development Services (ICDS) programme". **1992-1993.**

MAILING ADDRESS:
'SARASWATHI'
124/B, VARTHUR ROAD
NAGAVARAPALYA
BANGALORE-560093, INDIA
PH: 0091-80-5242999
FAX: 0091-80-5288098