Annual Report

Food Security in Bangladesh: Improving Wheat, Maize and Papaya Production and Impacts of Arsenic Contamination

July 2003-June 2004

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CIMMYT

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Table of Contents

Executive Summary

The Annual report for 2003-04 encompasses the accomplishments of the activities based on time frame and targets as per budget provision of the program covering eight components of the program, "**Food Security in Bangladesh: Improving Wheat, Maize and Papaya Production, and Impacts of Arsenic Contamination."** The major objectives of this program were meant for enhancing production of sustainable food security in Bangladesh. In addition, there are some fixed intermediate objectives set forth by USAID for implementation. These are:

a. Strengthen the partnership between the National Agricultural Research System (NARS)-NGO-Private Sector-CIMMYT and US Universities to achieve the goal of food security through wheat, maize and papaya production enhancement saving scarce natural resources and for better human nutrition.

b. Assist the Wheat Research Center, Horticulture Research Center (HRC) and Plant Breeding Division of BARI in their efforts to increase productivity of wheat, maize and papaya in Bangladesh.

c. Improve the rice-wheat system research activities of Bangladesh and strengthen exchange of research experiences in the subcontinent.

d. Offer leadership in assessment of the impacts of arsenic contamination on food security in Bangladesh.

e. Build human capacity in Bangladesh to address food security issues in the targeted institutions.

f. Assist Government of Bangladesh in technology and extension strategies where appropriate for agricultural sectors to sustain self-sufficiency of food production.

1) In the second year (2003-04) of the **Arsenic Program**, the major emphasis was on a nationwide survey to assess the nature and extent of the **arsenic problem in different agro-ecological regions of the country**. Irrigation water, surface water, soil and crop (both rice and other crops) samples were collected from 184 unions of 92 thanas across the country in the Boro 2004 season. Samples are being analyzed in the Bangladesh partners' laboratories. The arsenic content in surface waters (ponds, rivers, etc.) was found to be negligible in the arsenic problematic areas of southwestern Bangladesh. In such areas, wherever possible, use of surface water for irrigation could be a tool to avoid arsenic contamination of the soils and crops. Evidence of iron oxides partially retaining arsenic in the soil has been gathered. This is important for Bangladesh where the STW irrigation water and soils contain high iron.

A BARI-CIMMYT Arsenic Laboratory was established with the signing of a LOA with BARI. A new atomic absorption spectrometer for BARI and accessory equipment has been procured as the cornerstone of this laboratory. The laboratory is being further developed to an international standard where international partner

scientists graduate students from USA and Bangladesh can do analytical work on arsenic.

Three scientists started PhD degree studies BAU and one at Cornell University, USA since July 2003. These fellows are working on such topics as arsenic movement and arsenic balance in the water–soil-plant system, spatial variability of arsenic in water, soils and crops, effect of water management and phosphorus-arsenic interactions. Their research is expected to greatly improve the understanding of the arsenic problem in Bangladesh agriculture and provide a basis for the development of arsenic management strategies.

2) Based on socio-economic situations as well as land holdings in the country, **hand tractors and their accessories** were being promoted for livelihood improvement through conservation of resource conservation technologies in the project areas. This approach helps in reducing turn around time between rice harvest and wheat planting on time improving productivity of crops as well as intensification and diversification of agriculture. Appropriate equipment was made available through importation and/or manufacture through local entrepreneurs. The equipment such as multiple crop seeders, strip till seed drill, bed planter, zero till seed and fertilizer drill, multiple crop reapers, potato planter, high speed rotavator, are developed and well focused for promotional activities. During the year 2003-04, a total of 1,489 hectares of land were planted to wheat, rice, maize, mustard, mung-bean, chickpeas, lentil, jute, onion, garlic, etc. by the accessories. A total of 2,578 farmers directly benefited from the Bangladesh Hand Tractor (BHT) accessories for different crop production activities.

3) The **BCA – a two-year project which phased out in June** 2004 created an environment for inter-organizational working capability, which has encouraged strong cooperation, interaction and data sharing between project partners and other Bangladeshi organizations. The BCA now provides one of the most data-rich integrated sources of information currently available in Bangladesh. Besides, this project can identify data gaps and enable updating and generation of new or existing data sets. During the project period, four versions of BCA have been developed and 1000 CDs distributed. More than 903 people throughout Bangladesh representing GO, NGO, universities, and private sector have attended the BCA dissemination and training workshops. Two policy workshops were organized where more than 70 policy makers, donors, and higher authorities attended and contributed valuable comments/feedback on the BCA. The execution of 11 mini-grants to GO and NGO users provided the scope for application of BCA to many areas ranging from crop or variety suitability mapping to preliminary food insecurity mapping. The success of BCA is encouraging others to pool new information within the BCA. For example, poverty mapping data originated from the IRRI/BARC/LGED project is now integrated into the BCA.

4) A gender unbiased participatory technology transfer system through **whole family training** has been used successfully for promotion and adoption of maize

production technologies. During this year 380 trainers were developed who trained 3,236 families in 20 districts. For training, 8,000 training manuals, 150 sets of large posters, 300 video CDs were prepared and distributed. Moreover, a total of 35 mid- and senior-level officers and 25 field level technicians of Bangladesh Agricultural Development Corporation (BADC) were trained on maize hybrid seed production practices. Various demonstrations i.e., i) Demonstration of maize cultivation knowledge; ii) Varietal demonstrations; iii) Quality protein maize (QPM) demonstration in multi location; iv) QPM (Var. HQ2000) production demonstration; v) Production Demonstration of BARI Hybrid Maize were conducted. Feeding trial on a QPM based diet with broiler, layer and goat was done in collaboration with Bangladesh Livestock Research Institute. One hundred one CIMMYT germplasm was evaluated by NARS partners who selected eleven entries for further advancement. Twenty-six hybrid maize of different seed companies was tested for determining adaptability and yield potentiality. Three varieties were found acceptable with great potential for cultivating in Bangladesh. The whole family training concept has further been expanded to World Fish, Winrock International and Department of Agricultural Extension.

5) Progress has been achieved in Development of **Ring Spot Virus Resistant Transgenic Papaya**. The strains of PRSV-P have been collected from different parts of the country and preserved on silica gel in petri dishes and vials. These materials will be tested against the resistance in Hilo Hawaii and subsequently a local variety transformed as a transgenic. These will be tested there and will be brought back in the country for final evaluation and release as commercial varieties. Besides, the intervention in relation to regulatory and bio-safety regulations is at the final stages for approval.

6) The video and live drama developed and displayed in **Agro-food nutrition program** at Chakaria has created significant awareness and motivational changes in the community through growing vegetables at homesteads and farms as well as ready available of rickets affected children in the therapy and treatment centres. Live dramas are innovative, demonstrative and attractive for the public. Both video and drama are displayed based on the situation and opportunity. Seed demonstration plots are being focused at the community level.

7) **Human resource development** activities aiming at capacity building in knowledge and managerial skills for concerned scientists, extension officers and farmers were successfully implemented. This was done through short term overseas training, participation in regional and international conferences, workshops, seminars, meetings, professional exchange visits, in country trainings, in maize and wheat. A total of seven WRC scientists attended short-term overseas training, thirteen wheat and seven maize scientists and professionals participated in regional and international workshops, and fifteen scientists and professionals exchanged visits in the region. This program has exceeded the target but was carried out within the budget set up in our annual plan. Recently Bangladesh was rated highest in HRD program with CIMMYT offices throughout the world..

8) **Monitoring and Evaluation** was accomplished by surveying over 42 districts in maize and wheat production. Our data showed that for the year 2003-04, 2,647 maize growers reported their estimated area was 1,354 ha (0.51 ha per grower), production was 10,231 tons and yields were 7.56 ton per ha. This represented an increase in area per farmer of 54% over the last year. Similarly, the national area is also estimated to have increased to about 50%, giving credence to our sample to represent the nation. The targeted yield has been estimated to be 7.56 t/ha and production 10,231 tons for the targeted year 2003/04.

Based on the survey, 1,744 growers reported their actual area was 460 ha (0.26 ha per grower), production was 1,139 tons and yields were 2.48 tons per ha for the baseline year 2002-03. For the year 2003-04, 1,719 growers reported their estimated area was 477 ha (0.28 ha per grower), production was 1,390 tons and yields were 2.91 tons per ha. This represented an increase in area per grower 8%, production 25% and yield 17%.

Introduction

This annual report for 2003-04 covers the accomplishments of the activities earmarked during the period under review based on time frame and targets as per the plan of action and budget provision. There are eight components in the program, namely, **Food Security in Bangladesh: Improving Wheat, Maize and Papaya Production, and Impacts of Arsenic Contamination.**

The eight components are:

1. Human Resource Development
2. Facilitation and Promotion for Adoption of Mechanization by Growers
3. GIS-Bangladesh Country Almanac
4. Whole Family Training in Maize
5. Papaya Improvement Through Viral Disease Resistance
6. Impacts of Arsenic Contamination on Agricultural Sustainability and Food Quality
7. Agro-food Nutrition Program in Chakaria
8. Monitoring and Evaluation of the Programs

These components are basically research and development ones and the activities are subjected to modification as and when necessary depending on the side-specific R & D demands. The quarterly major activities performed so far during the period July 2003 through June 2004 are described here.

Key activities of the program for 2003-04

Human Resource Development

- Short-term overseas research training
  - Wheat breeding / agronomy / pathology at CIMMYT, Mexico / CIMMYT outreach
  - Maize breeding / agronomy / pathology at CIMMYT, Mexico / CIMMYT outreach
- Regional / international exchange
  - Wheat scientist / program professional exchange among Bangladesh, India, Nepal and Pakistan
  - Maize scientist / program professional exchange among Bangladesh, India, Nepal and Pakistan
- Participation to regional & international
  - Professional wheat workshop meetings and seminars, etc.
  - Participation to international and regional professional wheat workshop meetings and seminars, etc.
  - Professional maize workshop meetings and seminars, etc
- Whole family training: Maize
- Short-term in-country training
- Internal review of wheat and maize

- CIMMYT team-building events
- Other research training:
  - Whole family training on nutrition from calcium-rich vegetables in Kumari, Lama Thana, Banderban district
  - Short-term training for Bangladeshi scientists / policy makers at CU / Hawaii University of
    - Virologist
    - Regulatory
    - Intellectual property rights

Facilitation and Promotion for Adoption of Mechanization by Growers

- Planning meeting with counterparts
- Accessories procurement locally / importation
- Operating manual modification and reprinting
- Survey on existing equipment
- Repairing and servicing of existing equipment
- Training of NGO, growers, operators
- Hand over the equipment to the end users
- Stakeholders meeting on last year progress and program finalization for next year
- Monitoring progress and use of equipment
- Seeder demonstration for different crops
- Wheat (new area), Rice, Maize, Legume, and other alternative seeder uses with full inputs (for 1 bigha of land in each demonstration)

Bangladesh Country Almanac (BCA)

- Technical Implementation Committee Meetings
- BCA dissemination workshops
- BCA training workshop
- Appraisal on the updated version of BCA 1.9
- Seminar for policy makers
- Documents published on mini grants and database
- Data assemble
- CD of BCA sent with data from BARC to CIMMYT Mexico for review
  - version 1.9
  - version 2.0
- BCA CD reproduced and distributed
  - Version 1.0
  - Version 1.9
  - Version 2.0
- Training materials prepared (agenda, tutorial, evaluation)
- Mini grant reports and BCA publication
- Two or three upazillas identified for prototype higher resolution (large scale) BCA component

- Prioritize possible ACT improvements
- Training workshop conducted by CIMMYT expert
- BCA version released
  - version 1.0
  - version 1.9
  - version 2.0
- Mini-projects started and running
- Donor report
- Basic promotion activities: flier, WWW
- More BCA training at users' level
- Upazilla level digitization
- Land suitability maps for crop varieties at the Upazilla levels
- Collection of Greater Datasets from the GOB for incorporation including health, socioeconomic, etc.
- Increased project grants to BCA Networks partners over more years
- Use of all partners of USAID-supported projects' data in BCA with the assistance of USAID GIS personnel
- Field validations of various BCA outputs
- Crop wise fertilizer recommendations based on soil test value at Upazilla level

Whole Family Training in Maize

- Planning and review meeting with the partners
- Bangla manuals, posters, other documents preparation and printing
- English Video preparation on advance maize production and Bangla video multiplication
- Other training aids procurements (television, VCR, etc.)
- Trainers training
- Pre-assessment maize survey among the family
- 3,000 Farmer Families' training
- Viii. Maize germplasm importation & distribution among Gos / NGOs / private sectors
- Technology Demonstration:
  - Tillage option
  - QPM Feeding trial
  - Varietyal Demos
  - Culture practices
  - Bread making machine
  - Maize Sheller
  - Planning and review meeting with the partners
- Monitor to the trainers & farmers training, demo, experiments, farmers field
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Development of Ring Spot Virus Resistant Transgenic Papaya

- Work on regulatory and bio safety
- Help to GOB for implement intellectual property rights
- Survey for strains collections
- Development of the gene constructs, transformations
- Plantlets from transformation cultivated in GH

Impacts of Arsenic Contamination on Sustainability and Food Quality

- Equipment procurement, installation, optimization
- Short-term analytical traineeship in USA
- Graduate degree programs in USA / Bangladesh
- Visit of CU and TAMU partners to Bangladesh
- Survey of arsenic in STWs in Bangladesh
- Survey of arsenic in soils of Bangladesh
- Survey of arsenic content in food crops of Bangladesh
- Field experiments on arsenic mitigation
- Documentation of information on water, soil and crop arsenic
- Production of drama / video
- Test the impact of the dramas / video in 4 key locations, making assessments for future expansion
- Technical workshop on arsenic in water, soil and plant

Agro-food Nutrition

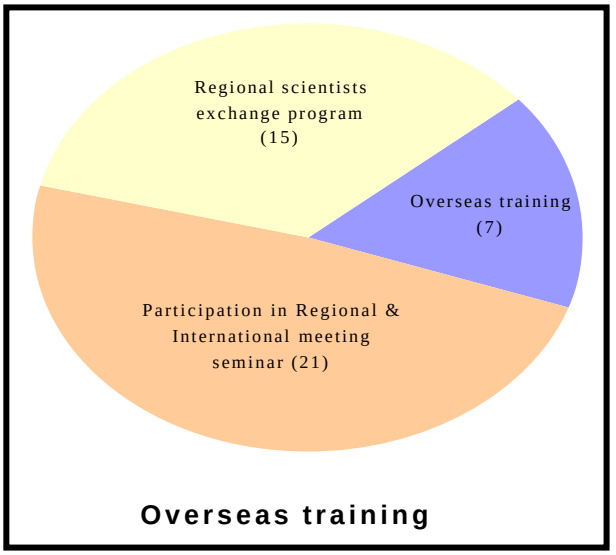
- Planning meeting with the collaborator
- Training aids preparation / demonstrations for high calcium vegetable garden demonstrations
- Family training arrangement
- Continue the community awareness on rickets, its causes and prevention

Monitoring and Evaluation

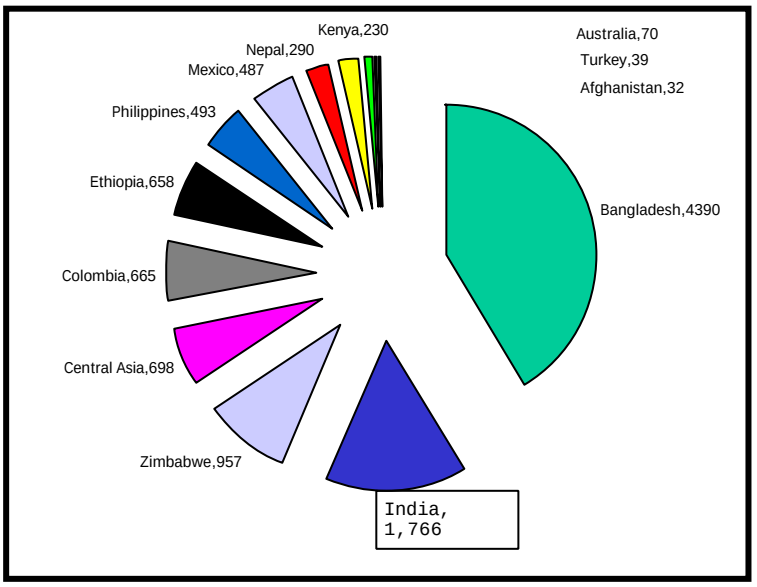
- Planning with the collaborators
- Survey questionnaire preparation
- Pre-assessment survey and report preparation
- Post evaluation and reporting
- Intensive investigation on the use of drama / videos for community awareness in Chakaria

Human Resource Development

Human resource development plays a key role in improving capacity building and management operation of the scientists, extension workers and farmers. In order to develop their skills provisions have been made in the project for short-term overseas training, participation in regional and international conference, workshop, seminar and meetings, professional exchange visits, in country training, survey and team building events on wheat and maize improvement. During 2003-2004, the programs implemented on human resource development have exceeded the target but carried out within the budget set up in our annual plan.



Recently, for a World Bank study, CIMMYT HQ conducted a survey of the entire CIMMYT trainings throughout the world. The figure below clearly shows how Bangladesh HRD has the highest priority of any office in the world—and it is due to the tremendous investment of USAID in this program.



I. Short term overseas training

The project was targeted for two wheat and one maize scientists for short-term overseas training on breeding, pathology, agronomy improvement courses in CIMMYT Mexico or other institutions. A total of seven WRC scientists attended the short-term overseas training as follows:

- Five wheat scientists received training on bed planting and wheat improvement courses for 1-3 months in CIMMYT, Mexico

- One wheat pathologist went to DWR Regional Station Flowerdale, Shimla, India for a period of one and a half months to screen one hundred wheat germplasm from Bangladesh for rust resistance
- One soil scientist received one month training at the Cornell University, USA in the use of liming and testing of soils for determination of lime requirements (funds were from SM-CRSP but facilitated by CIMMYT).

II. Regional/international exchange

a. Wheat scientist/program professional exchange among Bangladesh, India, Nepal and Pakistan

- One WRC scientist and one personnel from CIMMYT Bangladesh imparted a training course on Alpha Lattice Design to eighteen NARC scientists in Islamabad, Pakistan from February 8-13, 2004
- Two professionals from Pakistan visited wheat research and production fields including BHT accessories in WRC, Dinajpur from March 8-13, 2004
- CIMMYT wheat breeder from Nepal attended the Internal Research Review Workshop of WRC as an expert member from June 7-10, 2004
- One professional from CIMMYT India and one from CIMMYT Nepal visited CIMMYT Bangladesh in July 2003 for about 5 days to exchange ideas and sharing views on accounting and office administrative systems.

b. Maize scientist/program professional exchange among Bangladesh, India, Nepal and Pakistan

- A team of three maize scientists from India, Nepal and CIMMYT Mexico visited Maize research and seed production programs of BARI and BRAC from April 12-15, 2004
- Five scientists and professionals from BARI, BRAC, private entrepreneur and CIMMYT visited maize research and development programs in Vietnam from May 23-28, 2004 (trip report on CIMMYT web page)

III. Participation to international and regional wheat and maize workshops, meetings, seminars, etc.

a. Wheat

- One Program Manager of CIMMYT Bangladesh and one private entrepreneur attended a workshop on agricultural machinery held in West Bengal, India from July 28-30, 2003

- CIMMYT Agronomist attended R-W meeting in Delhi, India from August 25-28, 2003
- Director, Wheat Research Center and Chief Scientific Officer, Water and Irrigation Management Division of BARI participated in a challenge program workshop in India from August 27-31, 2003
- Four senior scientists of BARC, BARI, BRRI and CIMMYT attended Regional Technical Co-ordination Committee and Steering Committee meetings on Rice-Wheat Consortium for the Indo Gangetic Plains in Islamabad, Pakistan from February 6-12, 2004
- Two WRC scientists and CIMMYT Agronomist attended a workshop on Accelerating Technology Adoption to Improve Rural Livelihood on the Rainfed Gangetic Plains held in Delhi, India from February 14-18, 2004
- CIMMYT Agronomist visited Pakistan to attend RWC meeting and to see zero tillage development on wheat from April 15-26, 2004
- CIMMYT Agronomist also visited IFAD, ILRI programs in India and other activities including visit of Cornell University, USA from June 10 to July 29

b. Maize

- Three professionals from BARI, BRAC and CIMMYT attended a meeting on Asian Maize Biotechnology Network (AMBIONET) held in Chang Mai, Thailand from November 3-7, 2003
- Two BARI scientists and two BRAC managers attended a training on Maize Productivity in Hyderabad, India from February 1-13, 2004

c. Facilitation

- Besides USAID funding, CIMMYT Bangladesh has facilitated ten WRC scientists to attend IFAD meeting and PVS workshop in India and Nepal, respectively.
- CIMMYT Bangladesh also facilitated a CABI workshop on Identifying Agricultural Knowledge Systems and overcoming blockages to enhance uptake of agricultural Technology held in Dhaka form May 5-7, 2004. A total of nineteen foreign scientists and professional from UK, Nepal, India, Pakistan and CIMMYT HQ attended in the workshop. Three Bangladeshi scientists from BARI also participated.

IV. In country short term training

a. Facilitation and promotion for adoption of mechanization by growers (specially in seeder, reaper, bed planter, etc.)

One hundred seventy eight power tiller operators, mechanics and farmers were trained on the operation and maintenance of BHT accessories.

b. Dissemination workshop on GIS-BCA

A total of 462 scientists / professionals participated in the dissemination workshops on GIS-BCA from different institutions / organizations.

c. Whole family training on maize

A total of 3,100 whole family training on maize cultivation was imparted in collaboration with BARI, DAE and NGOs. This is 70% more in comparison to last year's achievements.

d. Training on hybrid seed production of maize

Training programs on maize hybrid seed production were organized in two batches one in October 2003 and other in April 2004 by BARI in collaboration with CIMMYT. Sixty participants from BADC and private seed producers attended the training course

e. English business writing skills training course

Forty-three WRC scientists including five CIMMYT staff participated in a weeklong training course on English Business Writing Skills at WRC, Dinajpur in January 2004. British Council trainers conducted the training

V. Participation to other activities

a. HIV/AIDS awareness classes

About two-hour long awareness classes on HIV / AIDS were held at the CIMMYT office on May 3, 2004 conducted by the Family Health International. All CIMMYT team members participated.

b. Internal review of wheat and maize

The annual internal research review workshop of WRC was held at BARI seminar room, Joydebpur from June 7-10, 2004. Seventy-five participants from WRC, BARI, DAE, BADC, SCA and CIMMYT including few expert members

from home and abroad attended in the review workshop.

c. Millers and bakers stakeholders meeting

A group of fifteen Millers and Bakers from different parts of the country visited WRC experimental fields and attended in a meeting on wheat quality on March 8, 2004. Besides presenting few papers on quality aspects, participatory discussions were made. It was felt that more bakers need to be involved and a workshop on quality may be organized soon by inviting one wheat quality expert from CIMMYT, Mexico to educate the millers and scientists on the quality factors.

VI. Other research training
(Papaya and arsenic)

- Member Director (Crops) of BARC and CIMMYT Agronomist visited Hawaii University, USA from October 19-27, 2003 for screening arrangements of Ring Spot Virus free papaya program.
- One BRRI scientist has been sent for Ph.D. degree program in Cornell University, USA in February 2004 from the arsenic project

VII. Overseas scientists, consultants and visitors

Scientists and professionals from CIMMYT Mexico and outreach CIMMYT programs, Cornell University, Texas A & M University, DFID, CABI, RWC etc. visited the maize and wheat research and development programs, adoption of Bangladesh Hand Tractor and Accessories, BCA Country Almanac, arsenic mitigation, SMCRSP, monitoring and evaluation of the CIMMYT Bangladesh program. A total of sixty-seven visits were made during this period. Some of the scientists also presented seminars to the NARS institutions/universities on the latest development of wheat and maize research in their respective fields and attended workshop.

List of scientists attended training, workshop, meeting and field visit during July 2003 to June 2004

Sl	Name & address	Subject	Period	Place	Fund source
I. Short term overseas research training					
1	Mr. Mostafa Ali Reza, SO, WRC, BARI	Wheat pathology	July 9-Oct. 17, 2003	CIMMYT Mexico	USAID
2	Mr. Mahbubur Rahman, SO, WRC, BARI	Wheat breeding	July 9-Oct. 17, 2003	CIMMYT Mexico	USAID
3	Mr. Badruzzaman, SO, WRC, BARI	Soil science	July 29-Aug. 28, 2003	Cornell University, USA	USAID
4	Dr. P.K. Malakar, SSO, WRC, BARI	Wheat pathology	Oct. 10-Nov. 20, 2003	Shimla, India	USAID
5	Mr. A. Khaleque, SSO, WRC, BARI	Bed planting	May 18-July 6, 2004	CIMMYT Mexico	USAID
6	Mr. A. Haider Hossain, SO, WRC, BARI	Bed planting	May 18-July 6, 2004	CIMMYT Mexico	USAID
7	Mr. M Anisur Rahman, SO, WRC, BARI	Bed planting	May 18-July 6, 2004	CIMMYT Mexico	USAID
II. Regional scientists exchange program					
1	Mr. Almol Gupta, CIMMYT India	Accounting and office administration	July 26-30, 2003	Bangladesh	USAID
2	Mr. D.B. Shah, CIMMYT Nepal	Accounting and office administration	July 26-30, 2003	Bangladesh	USAID
3	Mr. Masudul Hasan, CIMMYT Bangladesh	Statistical design	Feb. 8-10, 2004	Pakistan	USAID
4	Dr. Zahirul Islam Talukder, SSO, WRC, BARI	Statistical design	Feb. 8-10, 2004	Pakistan	USAID
5	Dr. Hafiz Muzibur Rahman, PARC	BHT	March 8-13, 2004	Bangladesh	USAID
6	Mrs. Seeda Somoroo	BHT	March 8-13, 2004	Bangladesh	USAID
7	Dr. Carlos Albarto Urrea, CIMMYT Mexico	Maize research	April 10-15, 2004	Bangladesh	USAID
8	Dr. Srinivasan, India	Maize research	April 10-15, 2004	Bangladesh	USAID
9	Dr. Niranjan, Nepal	Maize research	April 10-15, 2004	Bangladesh	USAID
10	Dr. CA Meisner, CIMMYT Agronomist	Maize research	May 23-28, 2004	Vietnam	USAID
11	Dr. M. Shahidul Alam, CSO, BARI	Maize research	May 23-28, 2004	Vietnam	USAID
12	Mr. S. Alam, Seed Specialist, BRAC	Maize research	May 23-28, 2004	Vietnam	USAID
13	Mr. Mizanul Haque, Doyel Agro Industries	Maize research	May 23-28, 2004	Vietnam	USAID
14	Dr. Nur E Elahi, CIMMYT Affiliate	Maize research	May 23-28, 2004	Vietnam	USAID
III(a) Participation to regional/international wheat workshops, meeting, seminar etc.					
1	Mr. Enamul Haque, Program Manager, CIMMYT	BHT workshop	July 28-30, 2003	India	USAID
2	Mr. Hasanuddin Sikder, Private Entrepreneur	BHT workshop	July 28-30, 2003	India	USAID
3	Dr. CA Meisner, CIMMYT Agronomist	RWC meeting	Aug. 25-28, 2003	India	USAID
4	Mr. Harun-Ur-Rashid, Director, WRC, BARI	Irrigation workshop	Aug. 27-31, 2003	India	USAID
5	Dr. Nurul Alam, EC, BARC	RSC/RTCC meeting	Feb. 5-12, 2004	Pakistan	RWC
6	Dr. Matiur Rahman, Director Research, BARI	RSC/RTCC meeting	Feb. 5-12, 2004	Pakistan	RWC

Sl	Name & address	Subject	Period	Place	Fund source
7	Mr. Harun-Ur-Rashid, Director, WRC, BARI	RSC/RTCC meeting	Feb. 5-12, 2004	Pakistan	RWC
8	Mr. Akter Hossain Khan, PSO, BRRI	RSC/RTCC meeting	Feb. 5-12, 2004	Pakistan	RWC
9	Dr. CA Meisner, CIMMYT Agronomist	RSC/RTCC meeting	Feb. 5-12, 2004	Pakistan	USAID
10	Mr. Harun-Ur-Rashid, Director, WRC, BARI	IFAD workshop	Feb. 14-18, 2004	India	IRRI
11	Mr. Elahi Baksh, SSO, WRC, BARI	IFAD workshop	Feb. 14-18, 2004	India	IRRI
12	Dr. CA Meisner, CIMMYT Agronomist	IFAD workshop	Feb. 14-18, 2004	India	USAID
13	Dr. CA Meisner, CIMMYT Agronomist	IFAD, ILRI and Cornell University	June 10-July 29, 2004	India and USA	USAID
14	Mr. Harun-Ur-Rashid, Director, WRC, BARI	PVS workshop	June 14-19, 2004	Nepal	DFID
15	Dr. M.A. Samad, CSO, WRC	PVS workshop	June 14-19, 2004	Nepal	DFID
16	Dr. M.A.B. Siddique, PSO, WRC, BARI	PVS workshop	June 14-19, 2004	Nepal	DFID
17	Dr. Moznur Rahman, PSO, WRC, BARI	PVS workshop	June 14-19, 2004	Nepal	DFID
18	Dr. D. B. Pandit, SSO, WRC, BARI	PVS workshop	June 14-19, 2004	Nepal	DFID
III(b) Participation to regional/international maize workshops, meeting, seminar etc.					
1	Dr. Nur-E-Elahi, CIMMYT Affiliate	Maize meeting (AMBIONET)	Nov. 3-7, 2003	Thailand	USAID
2	Dr. Al Amin, SSO, BARI	Maize meeting (AMBIONET)	Nov. 3-7, 2003	Thailand	USAID
3	Ms. Maksuda Khatun, BRAC	Maize meeting (AMBIONET)	Nov. 3-7, 2003	Thailand	USAID
4	Mr. Monzurul Kadir, SO, BARI	Maize training	Feb. 1-13, 2004	Hydra bad, India	USAID
5	Mr. Salahuddin Ahmed, SO, BARI	Maize training	Feb. 1-13, 2004	Hydra bad, India	USAID
6	Mr. Azharul Islam, Senior Manager (Maize), BRAC	Maize training	Feb. 1-13, 2004	Hydra bad, India	USAID
7	Mr. Kamakshi Hazra, Seed Technologist, BRAC	Maize training	Feb. 1-13, 2004	Hydra bad, India	USAID
IV. Participation to regional/international workshops, meeting, seminar etc. on papaya					
1	Dr. M.A. Razzaque, MD (Crops), BARC	Transgenic papaya research	Oct. 19-27, 2003	Hawaii University, USA	USAID
2	Dr. CA Meisner, CIMMYT Agronomist	Transgenic papaya research	Oct. 19-27, 2003	Hawaii University, USA	USAID
V. Ph.D. Program (Arsenic)					
1	Mr. Ziauddin Ahmed, SO, BRRI	Ph.D. soil science –Arsenic project	Feb. 10-Feb 10, 2008	Cornell University, US	USAID

List of overseas scientists, consultants and visitors during July 2003-June 2004

Sl	Name & address	Subject	Period	Fund source
1	Dr. K. Sayre, CIMMYT Mexico	BHT	July 9-12, 2003	USAID
2	Mr. Scott Justice, CIMMYT Nepal	BHT	July 9-12, 2003	USAID
3	Mr. Agustine Miemez, CIMMYT Mexico	Financial management system	Aug. 23-Sep. 2, 2003	USAID
4	Mr. Scott Justice, CIMMYT Nepal	BHT	Sep. 1-6, 2003	USAID
5	Dr. John Duxbury, Cornell University, USA	SMCRSP and Arsenic	Sep. 15-25, 2003	USAID
6	Dr. Julie Lauren, Cornell University, USA	SMCRSP and Arsenic	Sep. 15-25, 2003	USAID
7	Dr. Leoppert, Texas A & M University, USA	Arsenic	Sep. 20-28, 2003	USAID
8	Dr. K. Sayre, CIMMYT Mexico	BHT	Sep. 29-Oct. 13, 2003	USAID
9	Mr. Scott Justice, CIMMYT Nepal	BHT	Sep. 29-Oct. 13, 2003	USAID
10	Dr. Sam Page, CABI, UK	Project meeting	Oct. 25-29, 2003	CABI
11	Dr. T. Jefry, CABI, UK	Project meeting	Oct. 25-29, 2003	CABI
12	Dr. Etienne Duvillier	Project meeting	Oct. 25-29, 2003	CABI
13	Dr. John Duxbury, Cornell University, USA	SMCRSP	Oct. 30-Nov. 11, 2003	USAID
14	Mrs. Jackie, Cornell University, USA	Papaya research	Oct. 30-til today	USAID
15	Mr. Bernie King, Cornell University, USA	Papaya research	Oct. 30-til today	USAID
16	Mr. Scott Justice, CIMMYT Nepal	BHT	December 1-11, 2003	USAID
17	Dr. Masa Iwanaga, DG, CIMMYT	Wheat and maize research	January 5-8, 2004	USAID
18	Dr. Julie Lauren, Cornell University, USA	SMCRSP	Feb. 16-March 4, 2004	USAID
19	Dr. K. Sayre, CIMMYT Mexico	BHT	Feb. 16-March 4, 2004	USAID
20	Mr. Scott Justice, CIMMYT Nepal	BHT	Feb. 16-March 4, 2004	USAID
21	Dr. Larry Harrington, Director, CIMMYT Mexico	Wheat and maize research	Feb. 20-25, 2004	USAID
22	Dr. Jiang Feng, China	ADB	Feb. 25-27, 2004	USAID
23	Dr. Ortiz Ferrera, CIMMYT Nepal	PVS	March 1-5, 2004	PVS
24	Dr. M. Bhutta, NARC, Nepal	PVS	March 1-5, 2004	PVS
25	Dr. Michael Morris, CIMMYT Mexico	Monitoring and evaluation	February 7-15, 2004	USAID
26	Dr. Etienne Duvieller, CIMMYT Nepal	CABI meeting	March 17-23, 2004	CABI
27	Dr. Sam Page, CABI, UK	CABI meeting	March 17-23, 2004	CABI
28	Prof. R. Leoppert, Texas A & M University, USA	Arsenic	March 20-31, 2004	USAID
29	Prof. John Duxbury, Cornell University, USA	Arsenic	March 20-31, 2004	USAID
30	Prof. Julie Lauren, Cornell University, USA	Arsenic	March 20-31, 2004	USAID
31	Mr. Buddi Kanti Pokharel, NARC, Nepal	Solarization	March 22-28, 2004	SMCRSP
32	Mr. Rajendra Khanal, NARC, Nepal	Solarization	March 22-28, 2004	SMCRSP
33	Mr. Chiraijibi Adhikari, NARC, Nepal	Solarization	March 22-28, 2004	SMCRSP

Sl	Name & address	Subject	Period	Fund source
34	Dr. M. Morris, CIMMYT Mexico	Monitoring and evaluation	March 24-29, 2004	USAID
35	Dr. Dave Hodson, CIMMYT Mexico	BCA	April 22-30, 2004	USAID
36	Mr. Scott Justice, CIMMYT Nepal	BHT	May 8-15, 2004	USAID
37	Dr. Sam Page, UK	CABI workshop on technology transfer	May 3-9, 2004	DFID
38	Dr. F. Tahseen, UK	CABI workshop on technology transfer	May 4-9, 2004	DFID
39	Dr. Etienne Duvieller, CIMMYT Nepal	CABI workshop on technology transfer	May 4-8, 2004	DFID
40	Mr. Scott Justice, CIMMYT Nepal	CABI workshop on technology transfer	May 4-8, 2004	DFID
41	Dr. B.B. Tamang, Neapl	CABI workshop on technology transfer	May 4-10, 2004	DFID
42	Dr. Gonesh Sah, Nepal	CABI workshop on technology transfer	May 4-10, 2004	DFID
43	Dr. D.B. Gharti, Nepal	CABI workshop on technology transfer	May 4-8, 2004	DFID
44	Dr. Y.N. Ghimire, Nepal	CABI workshop on technology transfer	May 4-10, 2004	DFID
45	Dr. K.P. Bhurer, Nepal	CABI workshop on technology transfer	May 4-10, 2004	DFID
46	Dr. V. Kumar, India	CABI workshop on technology transfer	May 4-8, 2004	DFID
47	Dr. Ramesh Chand, India	CABI workshop on technology transfer	May 4-8, 2004	DFID
48	Dr. Arm Kumar Joshi, India	CABI workshop on technology transfer	May 4-8, 2004	DFID
49	Dr. Ram Vilas Pandey, India	CABI workshop on technology transfer	May 4-8, 2004	DFID
50	Dr. Singh Abha, India	CABI workshop on technology transfer	May 4-8, 2004	DFID
51	Dr. Tribhuvan Singh, India	CABI workshop on technology transfer	May 4-8, 2004	DFID
52	Mr. Shahid Parwez, India	CABI workshop on technology transfer	May 4-8, 2004	DFID
53	Dr. Ghulam Ali, Pakistan	CABI workshop on technology transfer	May 4-8, 2004	DFID
54	Dr. Buhsra Rashid, Pakistan	CABI workshop on technology transfer	May 4-8, 2004	DFID
55	Dr. Larry Harringhton, CIMMYT Mexico	CABI workshop on technology transfer	May 6-8, 2004	DFID
56	Dr. K.D. Johsi, CIMMYT Nepal	RWC meeting	May 14-20, 2004	DFID
57	Dr. Kamal Paudyal, CIMMYT India	RWC meeting	May 14-20, 2004	DFID
58	Dr. Sthphen Biggs, UK	BHT	May 10-12, 2004	USIAD
59	Mike Listman, CIMMYT Mexico	Technical editor	June 3-8, 2004	USAID
60	Dr. Memo Ortiz Ferrera, CIMMYT Nepal	WRC review	June 6-10, 2004	DFID

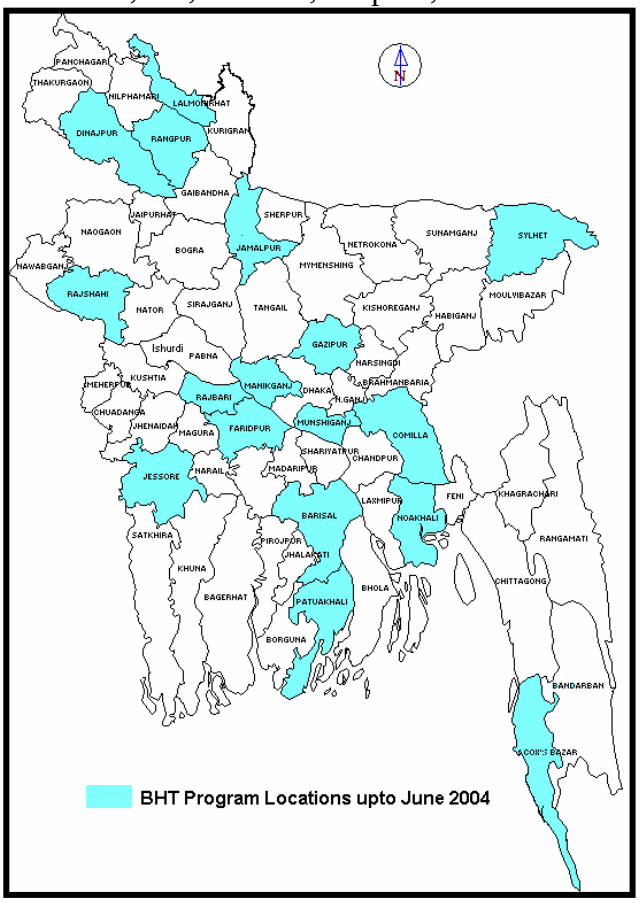
Facilitation and Promotion for Adoption of Mechanization by Growers

Rationale for Bangladesh hand tractor (BHT) introduction

Draft power for farming has been reduced over time due to frequent cyclones and floods affecting the number and cost of raising cattle. Agricultural labor forces are also being reduced due to urbanization and migration of the agricultural labor to urban areas and overseas. Under these socio-economic conditions and fragmented and small land holdings, big agricultural machinery is not affordable and feasible for sustainable livelihood for the Bangladesh farmers.

Furthermore, cropping intensity stands at more than 200 percent. Triple cropping is also in practice by an increasing number of growers. Failure to sow wheat on time reduces wheat yields by 1.3 percent per day planted after December 1, and more than 50% of growers sow wheat after this date. Late sowing of wheat is a major factor for obtaining reduced yields. To overcome these problems, the introduction of hand tractors and their accessories in the country is urgently needed.

In 1998, 72% of wheat growers reduced the turnaround time between crops by using hand tractors imported from China. Accessories, i.e., seeders, reapers, and others to hand tractors can reduce the time even more between rice harvesting and wheat sowing. Reapers can be used to cut the rice and lay the stalks on top of the ground, and reduced tillage wheat seeders can be used to open the soil with a seed drill, place the seed in the soil and then cover the seed in one operation. Reductions in turnaround time through reduced tillage practices can also promote crop diversification as new crops are introduced into rotations, and lead to substantial water savings, particularly wheat or other crops that are substituted for boro rice.

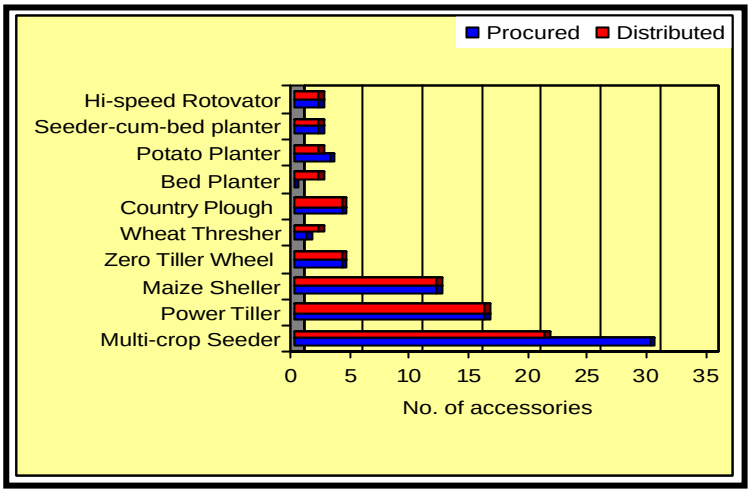


USAID granted funds for the period from July 2002 through June 2005 to CIMMYT Bangladesh for 'Facilitation and Promotion for Adoption of Mechanization by Growers' as a pilot program. The locations where hand tractor accessories have been sold or demonstrated are shown in the map of Bangladesh.

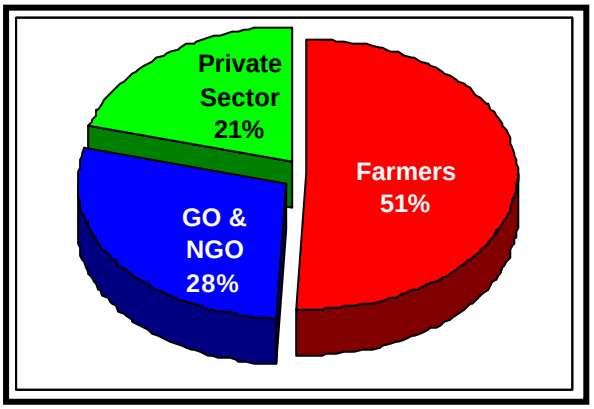
During the year 2003-04, achievements made on the program activities are highlighted in the following sections:

Accessories importation/procurement and distribution

For intensification and diversification of the existing cropping systems and conservation of agricultural resources for sustainable productivity and livelihood improvement, CIMMYT Bangladesh has developed new agricultural accessories, i.e., high speed rotovator, seeder cum bed planter, power tiller operated country plough, zero till wheel etc.



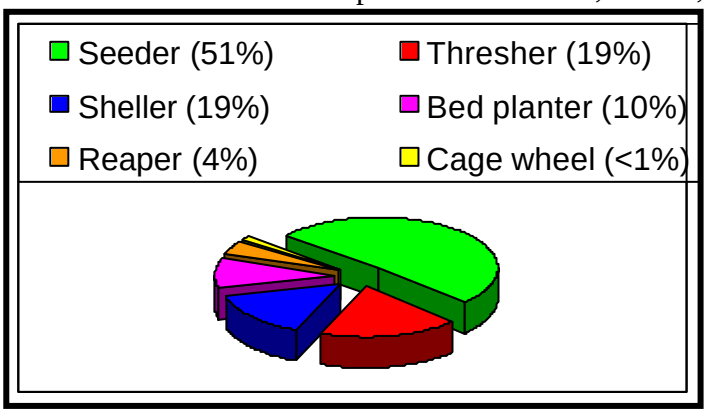
During this year CIMMYT Bangladesh has procured 66 accessories and distributed 57 of them to different stakeholders. Figure in upper right shows agriculture accessories and their distribution pattern.



Out of the total distribution, 51% of agricultural accessories were given to farmers, 21% to the private sector and 28% to GO & NGO as depicted in left side figure.

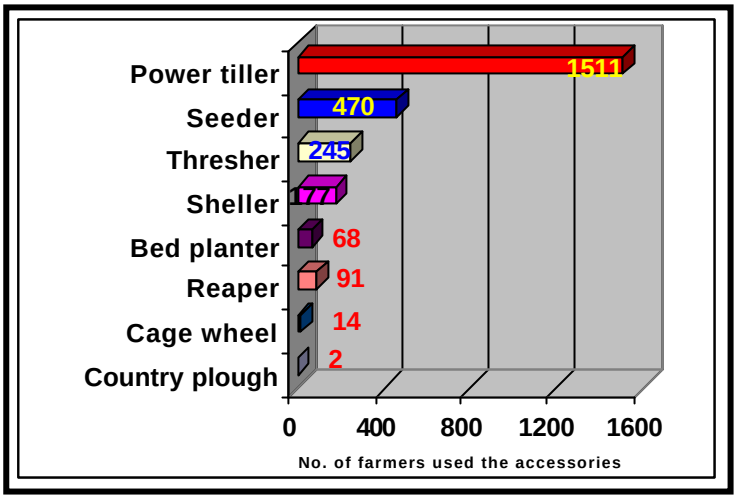
Area Coverage

During the year 2003-04, a total of 822 hectares of land were planted to wheat, maize, mustard, mung-bean, chickpeas, lentil, jute, onion, garlic, etc. by BHT accessories. Moreover, farmers used their power tillers for different crop production activities rather than rabi seasonal crops and covered a total of 1,156 ha land. The percentage of area covered by different accessories is depicted in the right side figure. This implies that the farmers/service providers have been utilizing these accessories more for their diversified uses in different agricultural operations in their farming.



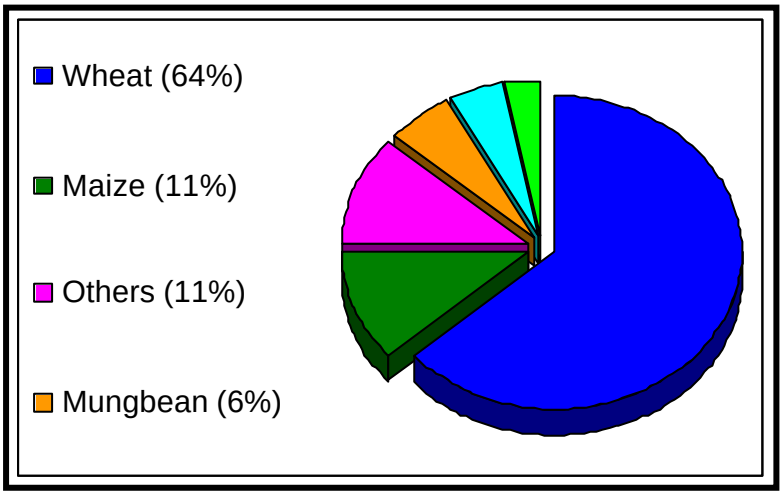
a) Farmers' agricultural accessories use status

During the year 2003-04, a total of 2,578 farmers used the Bangladesh Hand Tractor (BHT) accessories for different crop production activities. Figure in the right side shows number of farmers using different agricultural accessories for different crop production purposes.



b) Crop-wise area coverage (ha) by BHT program

During the year 2003-04, a total of 1,978 ha were brought under different crops by BHT program. Out of the total area, 822 ha were planted by the different BHT accessories. Figure in left side depicted the crops wise area coverage of BHT accessories. The major crop areas, i.e., wheat, maize mung bean, potato and onion for land preparation using these accessories are depicted in right side figure directly, and minor crop areas (ha) are grouped as others categories, i.e., mustard (17 ha), jute (16 ha), soybean (8 ha), sesame (7 ha), chili (6 ha), lentil (3 ha), ground nut (2 ha), chick pea (1 ha), directed seeded aman rice 40 decimal and others (11 ha).



Research and development of different BHT accessories

Based on farmers' need for diversified crop establishment by agricultural machinery and simplicity of the machinery uses in farmers' farming system, CIMMYT in collaboration with the GOB, NGOs and private sectors developed power tiller operated agricultural accessories. The following figures depict the promising machinery and their use in agricultural operations.

a) Multi-crop seeder

Three operations, land preparation, seeding and planking could be done in one pass by the multi-crop seeder. This accessory is operated by power tiller and the field performance is nearly 100%. In case of well trained operator, the field capacity of this accessory is about 40 decimal lands (0.4 acre) per hour and could save about ~50-60% seeding cost including land preparation and planking.

Compared to the conventional method, these accessories could save wheat seed by 20-25%. After harvesting T.Aman, the turn around time for the next crop could be reduced to no days. If the moisture of the soil is at field capacity this would result higher crop productivity.

Since this accessory sows the seed in line, making the inter-cultural operation, i.e., weeding, very efficient and thus weeding cost could be reduced to one third compared with that of weeding in broadcast wheat fields.

b) Strip till seed drill

Multi-crop seed drill was converted in to strip trill and establish wheat, maize and mung bean. Figure above illustrates the establishment of the crops by strip till drill method thus saving one-third fuel cost compared to the crop establishment by multi-crop seeder.

c) Bed planter

Conserving agricultural resources is a prime concern for sustaining agricultural production and environmental protection. To address this issue, CIMMYT and BARI developed a power tiller operated bed planter. The bed planters have been successfully demonstrated in farmers' fields for growing various crops, i.e., wheat, maize mung-bean, sesame etc. The above figures depict bed planter and wheat, maize, sesame and mung bean planted on bed.

d) Zero-till seed and fertilizer drill

A two-wheel tractor (Chinese) operated zero-till seed and fertilizer drill attachment has been developed jointly by the Wheat Research Centre of the Bangladesh Agricultural Research Institute and the International Maize and Wheat Improvement Center (CIMMYT). Prior land preparation, this machine can place seed and fertilizer directly into the soil in one operation. The zero-till drill could be hitched to the back of the Chinese two-wheel tractors. The zero-till seed drill has four major components, toolbar frame, furrow opener, seed delivery unit and fertilizer delivery unit. The performance of the machine has been tested in sixteen farmers' fields in different parts of Bangladesh for wheat, maize, mungbean and rice in 2003-04. The corresponding wheat yield was as good as or better than farmers' conventional practice. The effective field capacity of the machine was found to be 0.20 ha/hr for simultaneous seeding and fertilizer application. Planting cost of wheat and maize were 83% and 89% less than that of conventional method. The two-wheel tractor operated zero-till seed drill, thus, has a good potential as a resource conserving crop establishment technology for the Bangladeshi farmers. Figures below show zero-till seed and fertilizer drill (center) and the crops of wheat (right) and maize (left) established by the zero till seed and fertilizer drill.

e) Multiple crop reapers

A total of five units of the multiple crop self propelled reaper have been upgraded for reverse and forward gear added clutch, and demonstrated to the farmers' fields. The accessories performed very well. The effective field capacity is 40 decimal of rice or wheat land per hour. The fuel consumption is maximum half litter of diesel and the operation and maintenance cost is very low. Some problems were found during the demonstration, sinking problem in heavy clay wet land, power transmission problem from diesel engine to reaping unit, and poor quality metal was used in the frame. The self-propelled reaper has high demand at farmers' level. Emphasis should be given to import few units of self-propelled reaper from abroad for research and development, demonstrate to farmers, to train more engineering workshop and involve NGOs for selling the reapers. The reaper (right), wheat in the left top and rice in the bottom depicted in the above figures.

Two old (Rahman Engineering) power-tiller operated reapers had been repaired and demonstrated in Faridpur and Jessore for harvesting wheat during the last year. During the demonstration, it was observed that the power tiller-operated reapers were doing well compared to self-propelled reaper. The power tiller operated (PTO) reapers required more area for turning and the effective field capacity is 20-25% less compared to the self-propelled. The PTO reaper was not able to operate under wet land conditions. Our experience reveals that it is better to stop promotion of the PTO reapers.

f) Potato planter

WRC in collaboration with CIMMYT developed two types of power tiller operated potato planter, conveyer belt system and pin type. The conveyer system could be used for plating whole potato seed and the pin type for cut piece potato seed. Both types of the potato planters were tested and demonstrated on-farm sites in at Monshigonj, Dinajpur and Debigonj-Ponchagaor districts in collaboration with WRC and Tuber Crop Research Center (TCRC). On-station demonstrations were done at Dinajpur, Debibonj-Ponchagaor and Monshigonj in collaboration with WRC, OFRD and TCRC. The following figures depict the conveyer belt type potato planter along with a matured potato field planted by the machine at Monshigonj. Farmers opined

that though the conveyer type potato planter could plant potato within shortest time and save planting cost, since this method requires use of a whole tuber as seed makes it a costly input for the farmers. Growers suggested an alternative planter by which cut potato could be planted for saving seed cost. With this suggestion, WRC with CIMMYT's assistance jointly developed the pin type potato planter, tested and demonstrated with the potato growers at Dinajpur. However, CIMMYT recommends for both types as some potato growing areas require the use of whole tubers as well as cut tuber for other areas as potato seed.

g) High speed rotovator

Existing land preparation by power tiller for planting onion and garlic seedling is labour intensive, time consuming and costly. To address this issue, CIMMYT and Farm Power and Post Harvest Engineering Division of BARI developed the high speed rotovator. Two passes by this machine can pulverize the soil to the proper condition for planting garlic and onion as compared to 8-10 passes by existing power tiller. Thus the high speed rotovator can not only bring the soil to the good tilth condition for onion and garlic planting but could save times and cost.

In Rajbari district about 22 ha of onion and garlic land were prepared by the high speed rotovator and that created a demand for more use of the machine among onion and garlic farmers. In 2004-05, farmers placed and order for 8 units of this machine. CIMMYT and BARI have committed to deliver these machines. Figures above depicted the high speed rotovator (left) and an onion filed (right) prepared by this machine.

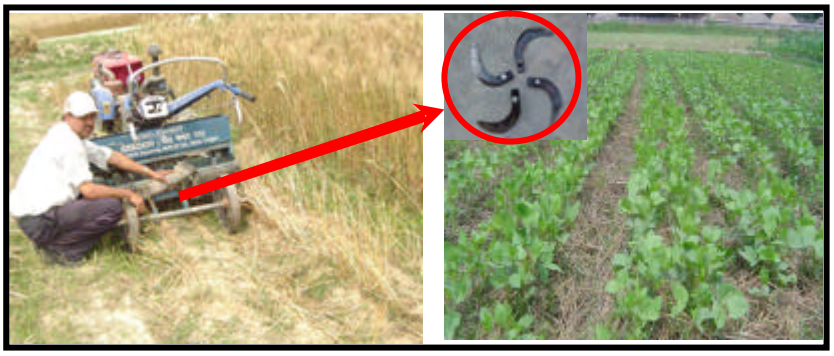
h) Seed drill cum bed planter

The Farm Power and Post Harvest Engineering Division of BARI with CIMMYT's assistance modified the existing seeder into bed planter. Two beds could be constructed at a time with 60 cm distance between the centers of the two

beds. The bed width and distance between the beds are adjustable within 120 cm according to the needs of the farmers. The seed drill cum bed planter was demonstrated at RARS Jessore experimental farm for sesame planting and BARI Gazipur experimental farm for maize.

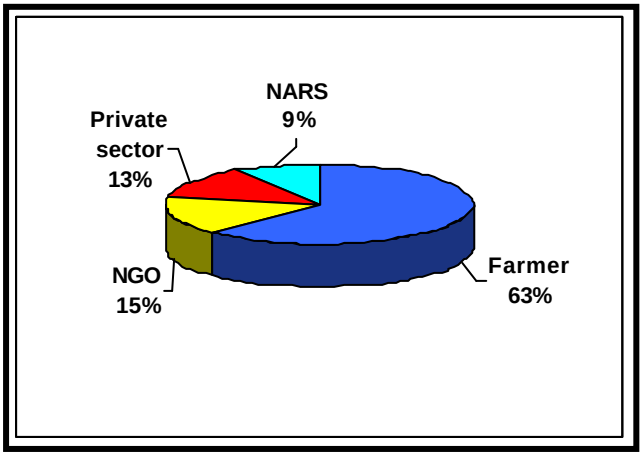
j) Seed drill for permanent bed

Planting crop on top of the permanent bed and managing crop residues by power tiller operated accessories is a big challenge. To address these issues, CIMMYT and WRC have developed new accessories that could be attached with the seeder. The accessories could till a strip on top of the bed, and plant the seed into the tilled strip. Above figures show the seed drill for permanent bed, mung bean on permanent bed sown by machine. The special type of blades (inset) that used in the machine can cut and leave the residues on the surface of the bed.



Training

During the year 2003-04, a total of 233 participants, farmers, NGO workers, private sector staff, and research organizations received in-service training on i) Power tiller operation and maintenance; ii) Multiple seed drill operation and maintenance; iii) Multi-crop reaper operation and maintenance; iv) Bed planting/formation; and v) other agricultural accessories.



The training was jointly organized by CIMMYT, BARI, BRRI and BAU at Wheat Research Center, Dinajpur, Regional Agricultural Research Station Jessore, On-farm Research Division, Faridpur, and Bangladesh Chashi Kollan Samity, Comilla. The figure in left side shows the distribution of participants from various institutions.

Technology expansion

CIMMYT - BARI together have developed potential agricultural accessories, i.e., seeder, zero tiller, bed planter, strip tiller, etc. All these were further scaled up among the farmers through a demonstration program of WRC funded by FAO—an additive project of CIMMYT's on-going BHT program. During the year 2003-04, the accessories were demonstrated in 10 locations of 5 districts, Dinajpur, Thakurgaon, Noyakhali, Jessore and Jamalpur.

Agricultural accessories fair

CIMMYT, in collaboration with NARS and universities, organized accessories fairs at Bogra and Dinajpur for familiarization of agricultural accessories among the growers, manufacturers, development agencies and service providers. This has created awareness about the benefits of using the accessories in agriculture among the stakeholders.

GIS-Bangladesh Country Almanac (BCA): A User Friendly GIS Tool for Agricultural, Forestry and Natural Resource Management

The Bangladesh Country Almanac (BCA) project started July 1, 2002 with the vision to increase the effective use and access of various stakeholders to integrated geo-spatial information related to agriculture and natural resources in Bangladesh. To achieve the vision, several components were needed e.g., suitable software tools, relevant data sets and effective diffusion / capacity building mechanisms.

The BCA project funded by USAID brought together three of the principal institutions in Bangladesh working in the agricultural sector. These were the Bangladesh Agricultural Research Council (BARC), which is the apex body of the National Agricultural Research System (NARS), the Bangladesh Rice Research Institute (BRRI), and the Soil Resource Development Institute (SRDI). Prior to the BCA project, each institution had established GIS facilities and acquired reasonable expertise with Geographical Information Systems (GIS) and used this capacity to develop a wealth of geo-referenced datasets related to their specific mandates and areas of expertise. However, there was little sharing of information between institutes or with the wider scientific community in Bangladesh.

Each partner institution recognized the value of improved and more widespread access to their data sets within their respective organizations and saw the country almanac concept and software as a means to achieve that goal. However, in order to obtain those benefits and be a valued member of the project consortium there had to be a commitment to more widespread sharing of information. With true professionalism, each institution has contributed extremely valuable datasets to produce some truly outstanding geo-spatial databases for the benefit of the Bangladeshi agriculture. A major success of the BCA project has undoubtedly been the integrated, collective work of the partner institutions involved in the project.

The result of these collective activities is a feature-rich series of geo-spatial databases at the national and local (Upazilla) level, which comprise the core component of the BCA package. Such an integrated set of information, including climatic, soils, crops, demographic, hydrographic and infrastructure information, breaks new ground in terms of an information resource for Bangladeshi scientists and planners.

Technical Implementation Committee (TIC)

For BCA program planning and implementation, a Technical Implementation Committee (TIC) was established with representation from the Bangladesh Agricultural Research Council (BARC), Soil Development Resource Institute (SDRI), Bangladesh Rice Research Institute (BRRI) and International Maize and Wheat Improvement Center (CIMMYT). The TIC decided the need of trainings, software

upgrading, data collection and modifications. During the project period and in the last year several TIC meetings were held either at CIMMYT or in the partner offices. TIC also acted to review and take feedback on the requirement of the stakeholders and pass it on to the Mud Springs Geographers (MSG) and CIMMYT, Mexico, in case those needed their action.

Training facilities developed at BARC

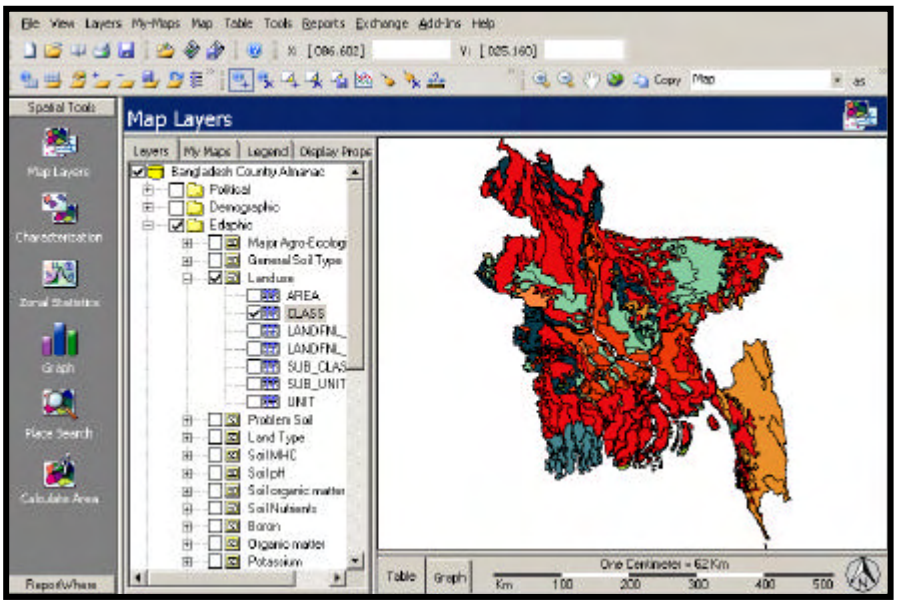
The project was instrumental in the creation of facilities at BARC to run hands-on training on BCA plus relatd others. For the purpose, BARC dedicated a separate room where, from the BCA, seven computers with accessories have been provided, while BARC has extended their internet connections to all those.

Release of software and database versions

During July 2003-June 2004, two more versions of the AWhere-ACT software and two database versions of the BCA have been released. Regarding software upgrading, much could be done during this fiscal year, because of the clearer need-assessment and understanding of the requirement by the TIC as well as the stakeholders. These were communicated to MSG, who in association with CIMMYT Mexico has fulfilled most of the suggestions. In respect of database development, significant work has been done in the collection, collation, verification and mapping of parameters like soil, climate, hydrology, demography and infrastructures, etc. In addition, BARC-IRRI project output on geographical mapping of poverty has been incorporated in the BCA version 2.0. All these together will serve as a 'ready to use' atlas for Bangladesh agriculture and natural resources management practitioners of the country.

AWhere-ACT software development

AWhere-ACT 3.6 was released as the final version of the two-year BCA project. Some bugs were fixed in this version though we received no complain from the users on hanging up the computers as happened earlier. Many enhancements have been included, along with all of the original spatial analysis functions



and utilities available in previous versions of AWhere Version 3.6. Along with the new and improved tools, there are now various icons and buttons throughout the interface

The new tools and features contained in AWhere 3.6 are listed and briefly described, as provided by the Mud Springs through the Awhere-ACT here.

1) New display properties interface: The map display settings for variables were previously edited via the Layer Properties dialog window. In previous versions, the Layer Properties window included a tab labeled "Display" where the display settings, such as symbol color scheme, class breaks settings, symbol style, symbol size, etc., were set and/or edited. All of these display settings are now edited via the "Display Properties" tab (available from the main interface when the "Map Layers" function is activated).

2) Customized class breaks settings: When using the Class Breaks display option (typically used when displaying Continuous type data), there is flexibility in designating the number and sizes of your class breaks, rather than settling only for a simple division of the entire range of values into "X" number of equal class breaks. The class breaks do not have to be uniform in size, nor are the colors of individual class breaks constrained to fall within a given color continuum. Any color in the spectrum can be selected for any class break, regardless of the currently selected color ramp.

3) Greater legend control: The new Display Properties tools give you greater control over how the Legend will appear on the Legend tab of the Map Layers function. It is possible to edit the settings for Class Breaks and Unique Value displays such that, if desired, an Alias for the individual Class Breaks or Unique Value items will be shown in the Legend, rather than the actual data values held in the data layer's attribute table.

4) Apply display settings to other layers: All of the display settings that are set for Class Breaks and Unique Value displays can be saved to an .xml file and applied to other data layers in the currently opened database, as well as to data layers in other, external database.

5) Copy map graphics from the interface: The new "Copy" tool on the toolbar directly above the map window allows you to easily and quickly copy an image of the Map, Legend, Graph (Chart), North arrow and/or Scale-bar to your computer's clipboard into several image file formats, including Metafiles. We may paste those images into external applications, such as MS PowerPoint® slides. Using the Metafile option, we can un-group the components of the image and make further edits to the image in the external application, such as moving map labels around, further customizing AWhere's output for your own needs.

6) Export wizard interface: The Export Wizard interface has been altered to make it easier to export Map Graphics images composed of whatever current map components you wish, including the Map, Legend, North arrow, and/or Scale-bar.

7) FGDC MetaData tool interface: The interface used to enter and edit Metadata is now accessible via the Layers drop-down menu. It was formerly accessed via an icon under the Spatial Tools module.

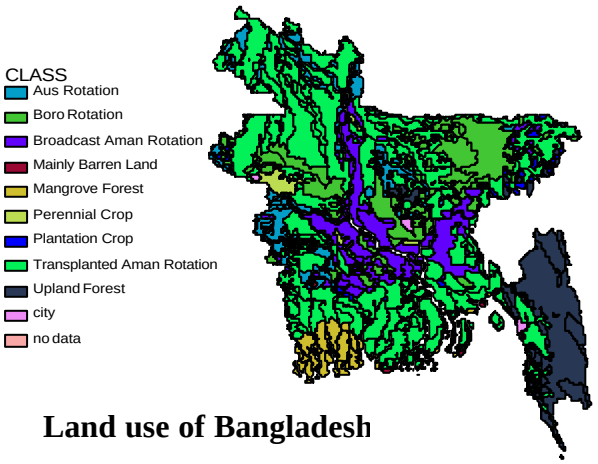
8) Add-Ins: The "Add-Ins" feature allows for the easy inclusion of new utilities and tools into AWhere subsequent to the initial release and installation of the software. Any Add-Ins that you install with AWhere will be listed in the Add-Ins menu. Add-Ins can be provided by Mud Springs, or can be generated and submitted by the AWhere user community for distribution.

9) Map charts moved: The Map Charts tool was formerly accessed on the "Layer Properties" dialog box. The Map Charts tool can now be accessed via the Layers drop-down menu, or via the "Map Charts" button on the AWhere toolbar. The Map Charts tool allows to place small pie or bar charts directly on top of mapped features in the Map View Window. Also, the legend for these Map Charts is now displayed on the Legend tab along with the legends for any other currently displayed data layers.

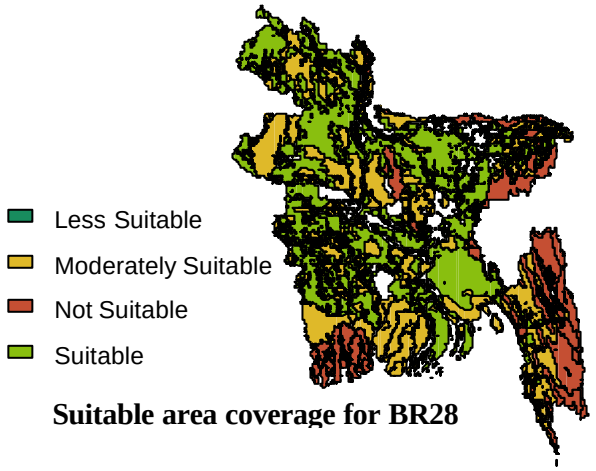
10) Table record <=> Map Feature Synchronization: With a data layer displayed in the map window, and its attribute table loaded in the Table panel, any table records selected in the table will result in the corresponding map features being highlighted on the map, and vice versa.

Database development and upgrading

Like previous years, all data has been incorporated by division, district and Upazilla. They have been kept in spatial form in shape files so those users can easily query



Land use of Bangladesh



Suitable area coverage for BR28

and display the data, varying the choice of map symbols and colors according to their needs. Data on soil/land was acquired from BARC and SRDI. Acquisition of climatic and hydrological data was made from Bangladesh Meteorological Department (BMD) and BWDB/WARPO respectively. LGEDs infrastructure data were procured for the BCA. Crop area and acreage were obtained from DAE and the publications of the Ministry of Agriculture (MoA). Upon upgrading and addition of parameters, creation of surfaces was made, to enable the users to derive outputs

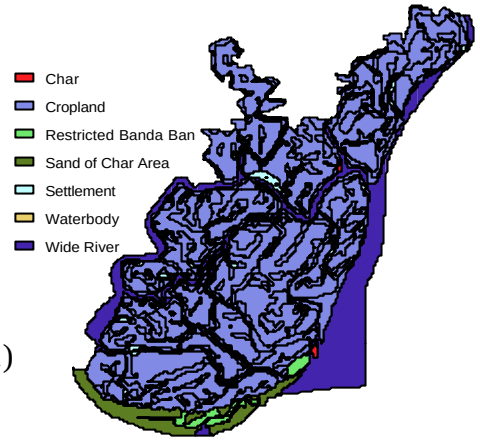
according to their need. These were performed by the partner agencies of the BCA. Further, historical databases on all crops and their coverage, irrigation, fisheries, livestock, nutrition data and detailed report of the BARC-LGED-IRRI poverty mapping study have been incorporated.

A list of the data layer/element, which included in the BCA databases within the two-year project, is furnished at the bottom of this report.

Upazilla/thana level spatial data

To facilitate access to data on a higher scale (1:50,0000) and to demonstrate ability of the BCA to address local level planning, the information on various features of the following three Upazilas (sub-district) have been provided in the BCA:

- Ghatail thana of Tangail district (most updated)
- Birganj thana of Dinajpur district
- Kalapara thana of Patuakhali district



Chemical and physical characteristics of soil

Like country level data, Upazilas' attribute data are also kept separately using external customized software.

BCA on the web

Over the last two years, BCA group could disseminate the information to nearly 1,000 practitioners, though we had the intention to reach much more. Taking advantage of the ICT (Information and Communication Technology), we tried to open up the BCA to everyone in the globe. As such, with the release of the final version 2.0 we have simultaneously floated the BCA on the following webs:

http://www.cimmytbd.org/bca

Suggestions and constructive criticism on the web site are welcome.

Software license

MSG provided to CIMMYT one copy of 'AWhere-ACT 3.6' software as a final release of the two years BCA project. AWhere-ACT can be distributed to any legitimate interested parties, CIMMYT and the partners approve. The user may install and use the software for the sustainable development of Bangladesh.

The AWhere-ACT 3.6 was accompanied by a runtime license, which allows users to test for a period of 60 days commencing on date of installation. When a user first attempts to launch AWhere-ACT 3.6, the license manager checks to see if there is a valid license for that application before allowing it to start up. If there is no license for the application, or if the license expires, it will automatically prompt to enter a new license code. Upon expiration of the runtime license, users must register with the CIMMYT Bangladesh/BARC for further renewal of license. CIMMYT Bangladesh/BARC will provide licenses (registration codes) for up to 200 active users free of cost. The BCA license renewals will revolve on an annual basis. The license expires after every one year and need for another request for a free license code renewal. CIMMYT will supply Mud Springs with full names and addresses of registered 200 users of the AWhere-ACT Software.

Video tutorial

A video tutorial has been prepared by the BCA team that helps the users to learn practically the various functions and the utility of the BCA. This is in addition to the tutorial database of the software provided by the MSG. The video is result of the demonstrations conducted by the team in different workshops. Now users don't need to go anywhere for further help to run BCA. The video CD runs automatically when inserted in the CD drive. User can easily understand the databases and the software through playing the video.

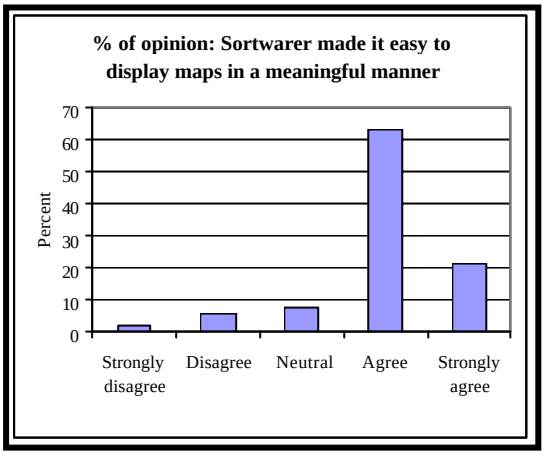
Dissemination/training workshop

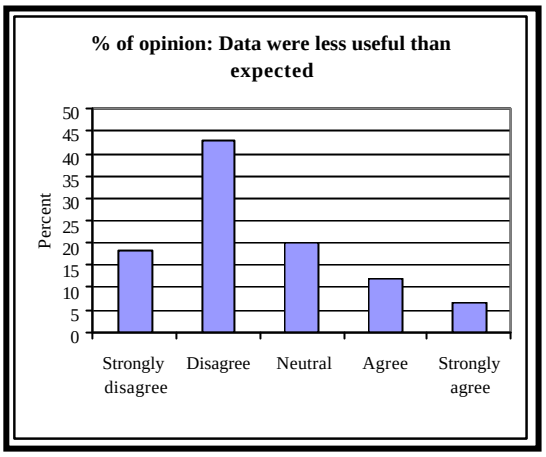
Several dissemination/training workshops were organized in collaboration with regional networks, NARS, NGOS and private sectors in different locations. Participants of the workshop took part in discussion for improving the software tools and data. Normally, an evaluation sheet would be distributed among the

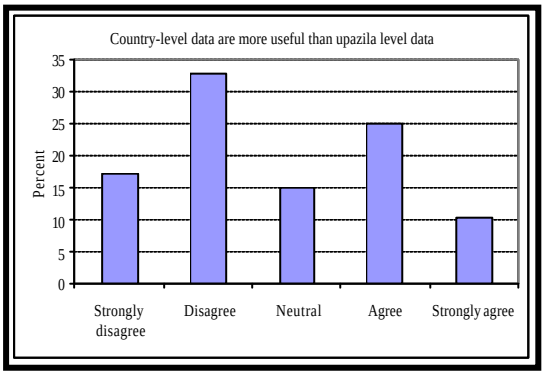
Professor A.J.M Nuruddin Chowdhury, Vice Chancellor of Chittagong University (CU) inaugurated the BCA dissemination workshop at the Auditorium, Institute of Forestry and Environmental Sciences, CU on April 4, 2004

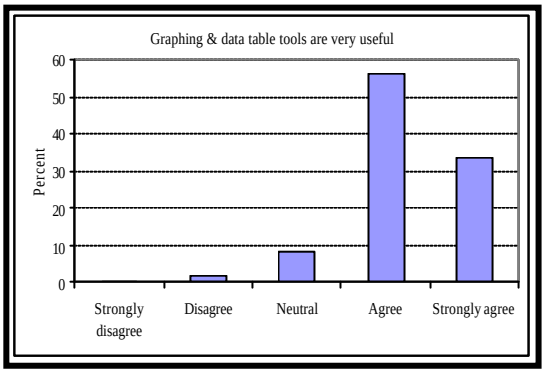
participants to get the feedback, which elicited extremely positive responses. They provided us more or less same type of appeal.

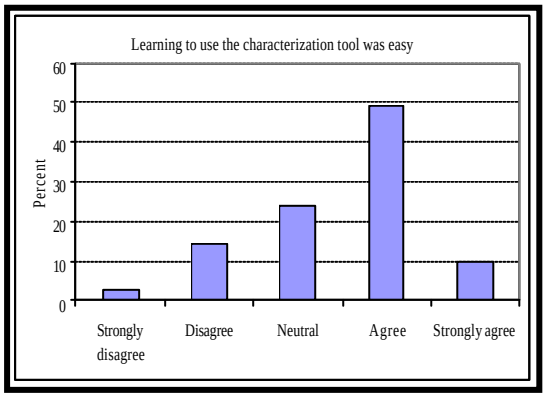
Some of their valuable comments on this question included: 1) Software made it easy to display maps in a meaningful manner 2) Data were less useful than expected 3) Easiness of the characterization tool 4) National-level data are more useful than Upazilla level data 5) Useful of graphic and data table, 6) Recommending BCA to others.

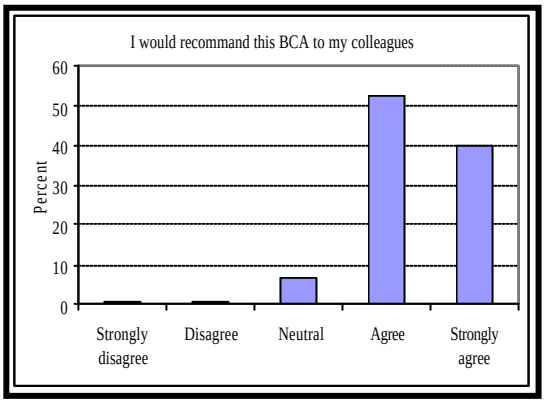












To mark the closing of the BCA project, a policy workshop was organized at BARC on June 28, 2004, where head of different agencies, representatives of various Government, donor and non-government organizations participated. Participants expressed deep satisfaction on the upgraded 2.0 version of the BCA and the capability of the software. They however, were enthusiastic and wanted to have

more and more information in the BCA. These were: information on market, higher resolution DEM, socio-economic data, transferable agricultural technology, forestry, fisheries, livestock and energy sector data, health data, agricultural implements and mechanization, pest and diseases incidences etc. The BCA group cordially accepted the valued comments and suggestions and expressed their eagerness to work on those if there is scope in future.

Dissemination/training workshops in different locations from July 2003-June 2004

Types of workshops	Location	Number of participants
Dissemination workshop	Rajshahi University, Rajshahi	90
Dissemination workshop	Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur	64
Dissemination workshop	Department of Agricultural Extension, Dhaka	87
Dissemination workshop	Bangladesh Sugarcane Research Institute, Ishurdi	100
Dissemination workshop	Chittagong University, Chittagong	
Training workshop	Hazi Danesh Agricultural Science and Technology University, Dinajpur	25
Policy workshop	Bangladesh Agricultural Research Council, Dhaka	50
Total workshop participants		**416**

Mini grant

This year, three more mini grants were offered in addition to those eight awarded last year. Completion of all the 11 mini grant activity was done as per schedule and reporting done during the current fiscal year. A list of the 11 mini grants executed is given below.

1. Delineation of Food Situation in Bangladesh: A Case Study on the Use of GIS-BCA Tool in Addressing Food Deficit Upazilas
2. Investigation on The Application of A Where-Act Software Package In Agriculture
3. Suitability Assessment for BARI Released Wheat Varieties with the Help of BCA –A User Friendly GIS Tool
4. Evaluation of Applicability of The GIS-BCA Information For Fisheries Resource Management
5. Suitability mapping of selected BRRI released varieties in boro season
6. Application of GIS-BCA Tool for Assessment of Environmental Situation in Three Different Agro-ecosystems in Bangladesh
7. Soil Suitability for Wheat Cultivation –A Case Study in Biral Upazilla, Dinajpur GIS-BCA Information
8. A Study on The Use of the Awhere-Act 3.5a Software Package in Bangladesh with Special Emphasis on Drought In Agriculture
9. Delineation of Food Situation In Bangladesh: A Case Study on the Use of GIS-BCA Tool in Addressing Food Deficit Upazilas
10. Application of BCA Tool for disaster Management in Agriculture
11. Suitability Assessment for Spices and Condiments with the Help of BCA -A User Friendly GIS Tool

Through the above mini grants, the BCA group could know further in its application towards development planning, characterization of research need and areas, validation of the BCA outputs and problems related to the software as well as the data provided. A workshop was organized at the CIMMYT Dhaka in presence of CIMMYT Mexico Head of GIS, findings of the study grants were made, discussed and several useful recommendations made. All those studies were considered useful, logical and thus transmitted to the MSG, which ultimately helped to further refine the software as well as the database.

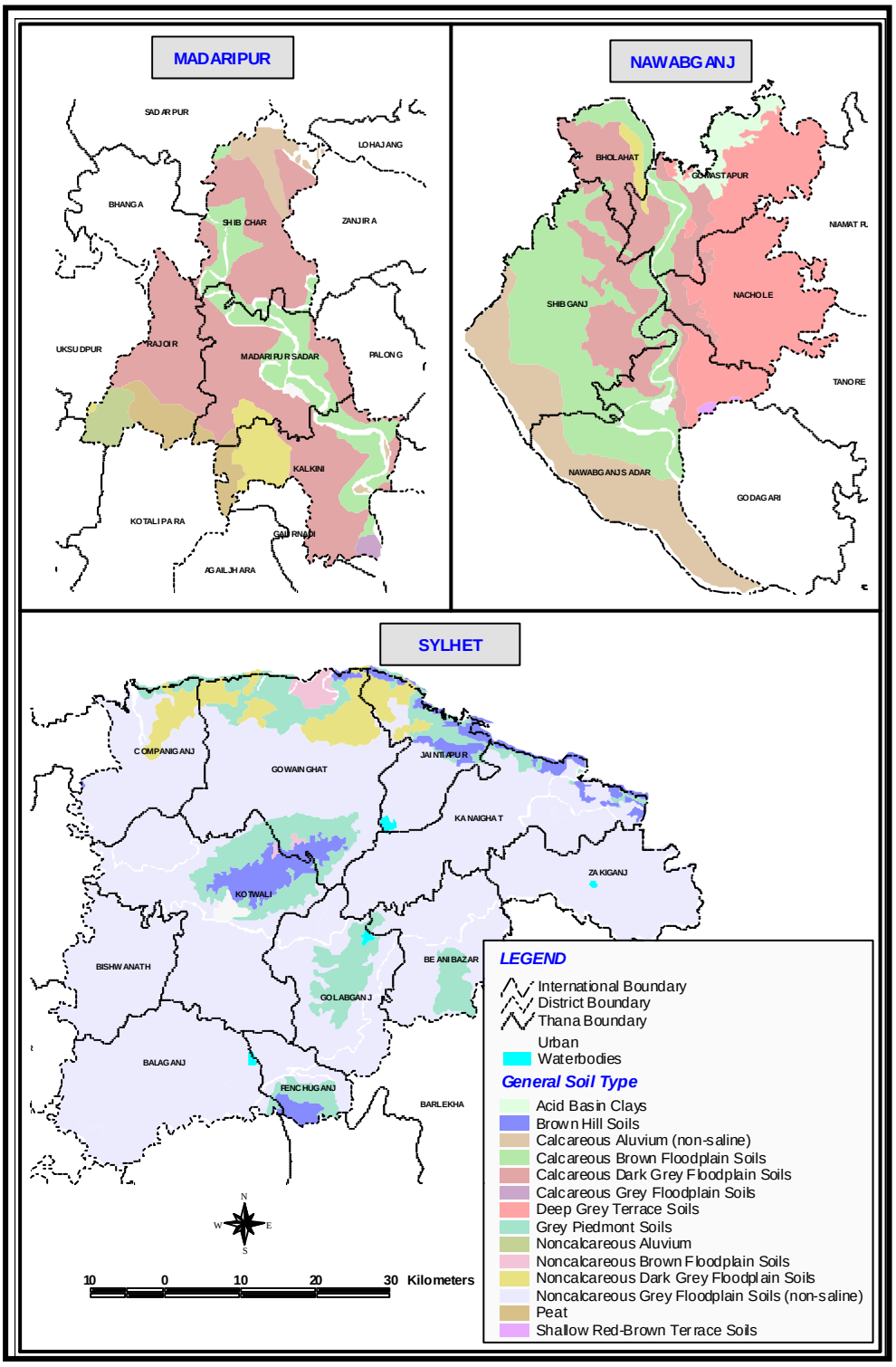
BCA in addressing problem areas

With the much awaited information and the tools provided in the BCA CD, a user can apply it for many different problem solving activities. While the researchers are using BCA in the identification of areas of research, the academicians are using it to assign tasks to the students for higher degree and the extension and NGOs workers using it for development programming purposes. It was felt necessary to document some of those as an example. The BCA's mini grant findings could be used here to

depict; as to what and how BCA helped in addressing a few areas of agricultural constraints and importance.

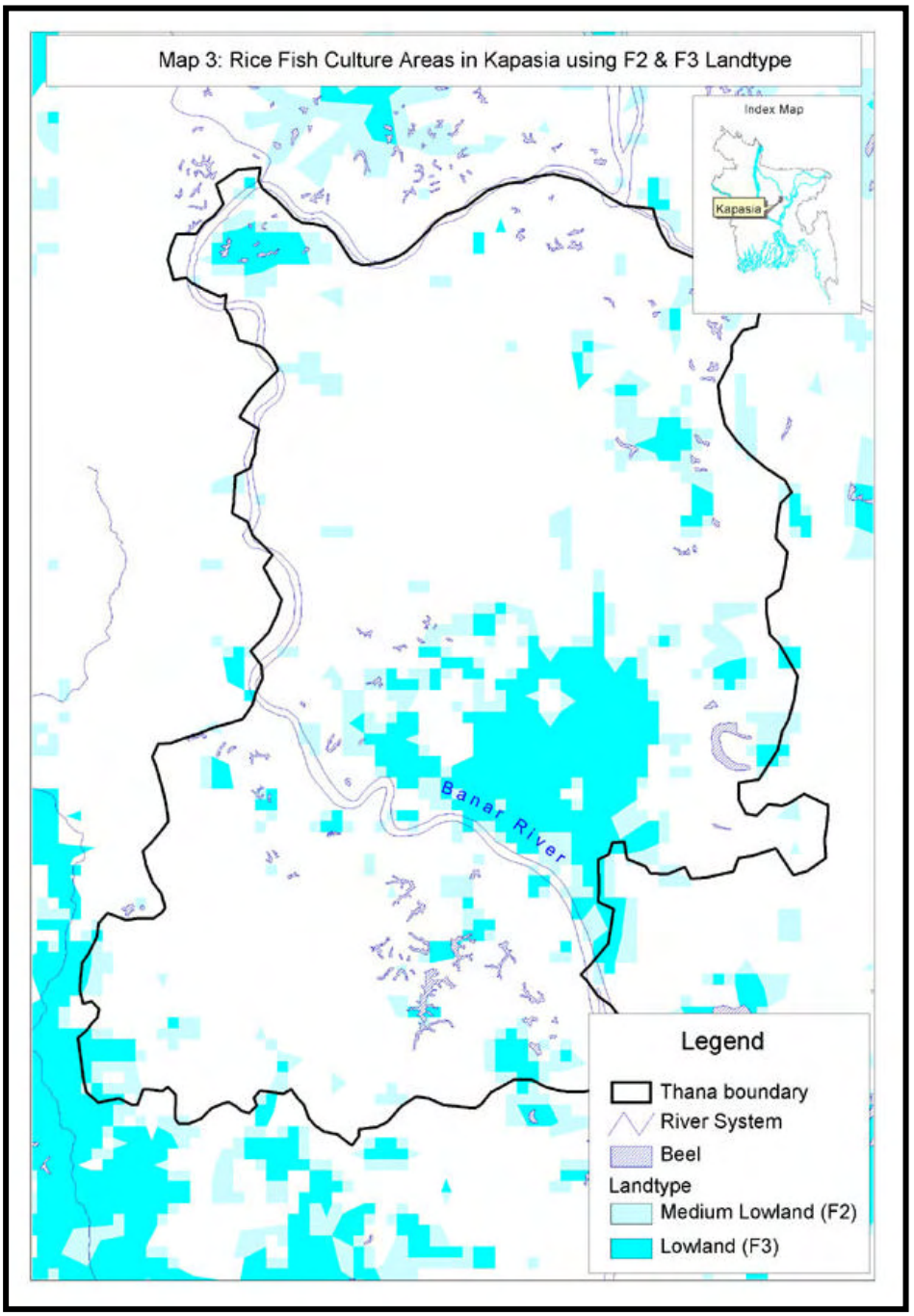
a. Understanding agro-ecological environments

BCA's database on biophysical resources provided opportunity to assess the agro-environment through systematic evaluations of the major factors of the environment; e.g. land, water, climate and vegetation. This exercise helped to locate opportunities and problems thereof and thus to prescribe to undertake agricultural development and mitigation measures. The figure below illustrates this:



b. Locating areas for fish culture

Fisheries' resources are being increasingly squeezed and the cultivation practices changed. Not many water bodies are found for open water fisheries at present. The present trend is to cultivate fish in rice fields, to increase income and to reduce protein deficiency. Against this backdrop, attempt was made to apply BCA in identifying areas where both paddies cum fish culture can be done. The success of the work is shown in the figure below:



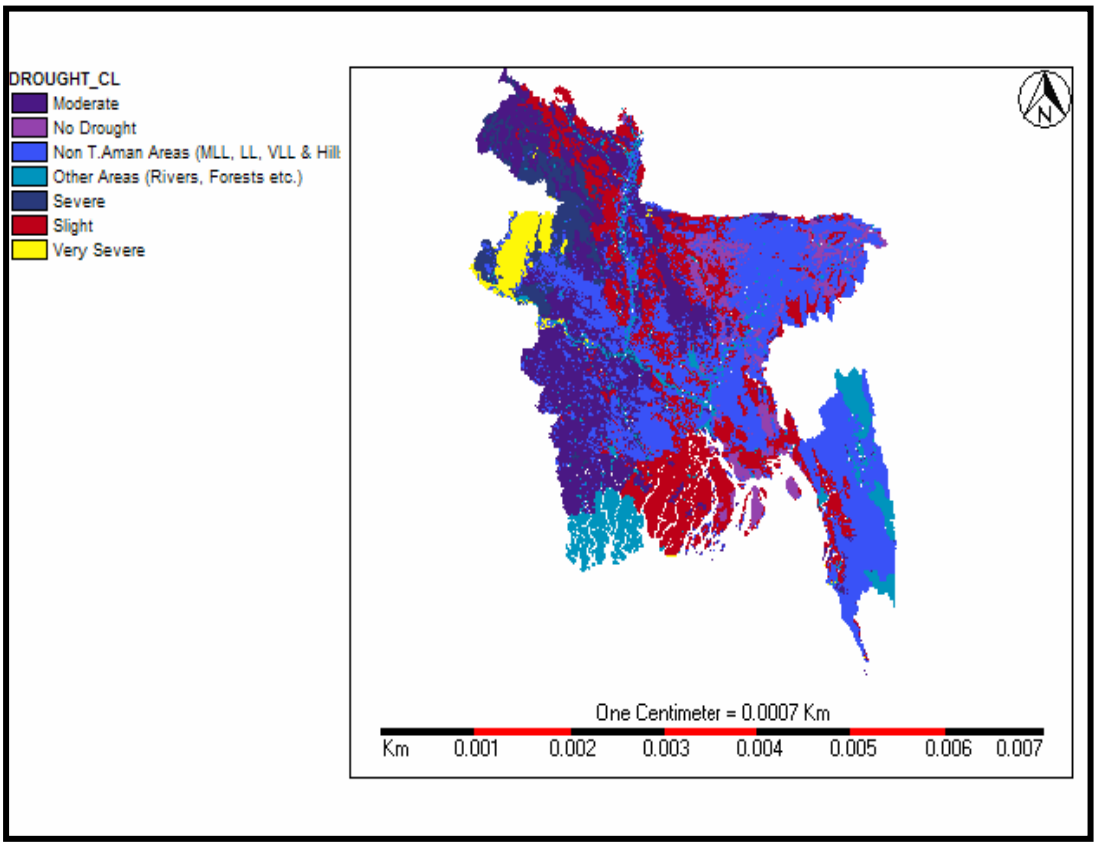
c. Localized agricultural production planning

Current agricultural production planning is done taking Upazila as the unit. This however, is not based on understanding the local resources and their

potential. Planning very often becomes impractical or not effective. Using BCA tool, a case study was done to apply it for local level planning from Upazila to DAE's blocks since the blocks form the basis of Upazila agricultural crop production planning. This has been done successfully using BCA and here is the example in picture.

d. Risk management in agriculture

Drought effects on agriculture are no less than flood in terms of crop loss. In severe drought years, depending on the variety, stage of crop etc. – crop loss, could be to the extent of 40%-60% of the normal year i.e. without drought stress. Risk management in agriculture was thus considered important to test using BCA tool. By the use of the BCA, one can delineate drought by severity and crop seasons and thus can take up steps to mitigate its effect. Case study in this regard demonstrated the potential of BCA to do such risk mitigation activities, as can be seen in the figure below:



A list of the data layer/element, which included in the BCA databases within the two-year project, is furnished below:

Elements/Data Layers		Description of the Variables
Political		
• Division	:	Administrative unit: Division
• District	:	Administrative unit: District
• Thana	:	Administrative unit: Thana / Upazila
Demographic		
• Population density	:	LandScan 2001 Global Population Database
• Pop. per District in 1991	:	District-wise Population of Bangladesh
• Pop. per District in 2001	:	District-wise Population of Bangladesh
• Adult Literacy in 2001	:	Adult Literacy Rate
• Literacy - All Ages in 2001	:	District-wise Literacy of all age groups
Edaphic		
• Landuse	:	Landuse Pattern of Bangladesh 1997
• Problem Soil	:	Problem Soil of Bangladesh
• Physiographic	:	
• Soil organic matter	:	Organic matter (OM) status of soils: Very
	:	Low=<1%, Low=1.0-1.7%, Moderate=1.8-3.
• Soil Nutrients	:	Soil Nutrient Status
• Boron	:	Boron Status Map Of Bangladesh
• Organic matter	:	Organic Matter Nutrient Status Map of Bangladesh
• Potassium	:	Potassium Nutrient Status Map Of Bangladesh
• Sulphur	:	Sulphur Nutrient Status Map Of Bangladesh
• Zinc	:	Zinc Nutrient Status Map of Bangladesh
• Phosphorus	:	Phosporus Nutrient Status Map of Bangladesh
• Clay Mineralogy	:	
• Salinity	:	Soil Salinity of Bangladesh 2000
• Drainage	:	
Soil Characteristics		
• Major Agro-Ecological Zone	:	Agroecological Zones of Bangladesh
• Topsoil Texture	:	Top soil texture (TX) 20 classes
• General Soil Type	:	General Soil Type of Bangladesh
• Soil Salinity	:	Soil salinity status (SI) 5 classes
• Soil Reaction	:	Soil reaction (pH) 5 classes
• Soil Permeability	:	Soil permeability (SP) 3 classes
• Land Type	:	Inundation Land Types
• Soil Moisture	:	Available soil moisture holding capacity (SM) 5 Classes
• Soil Depth	:	Effective soil depth (SD) 5 classes
• Soil MHC	:	Soil moisture holding capacity
• Soil Consistency	:	Soil consistency & workability (SC) 4
	:	classes
• Soil pH		Soil pH or Soil Reaction
• Slope	:	Slope (SL) 6 classes
• River Erosion	:	Disastrous river erosion hazard (RH) 2
	:	Classes
• Relief	:	Relief (RE) 5 classes
• Ploughpan	:	Very Firm / Hard ploughpan (PP) 2 classes
• Nutrient Status	:	Natural nutrient status (NS) 2 classes

Elements/Data Layers		Description of the Variables
• Hazard Frequency	:	Hazard frequency (HF) 5 classes
• Flooding Depth	:	Flooding depth (FD) 6 classes
• Flood Hazard	:	Disastrous flood hazard (FH) 2 classes
• Erosion Status	:	Erosion status (ES) 2 classes
• Drainage	:	Drainage (DR) 6 classes
• Calcic Phase	:	Calcic phase (CA) 2 classes
• Acid Sulphate	:	Acid sulphate phase (AS) 2 classes
• Alkaline Phase	:	Alkaline phase (AL) 2 classes
	:	
Infrastructure		
• Cities	:	
• Railways	:	Railways of Bangladesh
• Roads	:	Roads of Bangladesh
• Socio-economic location	:	Growth cetre and Hat/Bazar
Ecological		
• Flood 1998	:	Historical flood of 1998
• Flood Prone Areas	:	Flood Prone Area of Bangladesh
• Bio-Physio Constraint Areas	:	Biophysically Constrained Areas of
• Kharif Drought		Bangladesh
• Rabi Drought	:	Kharif (wet season) Drought
• Pre Kharif Drought	:	Rabi (winter or dry season) Drought
	:	Pre-Kharif (pre-monsoon) Drought
Natural Resources		
• Sundarbans	:	Sundarbans: Mangrove Forests of Bangladesh
• Reserve Forests	:	Reserve Forests of Bangladesh
Hydrographic		
• Ground Water Depth 2002	:	
• Ground Water Depth 2001	:	
• Ground Water Depth 2000	:	
• Ground Water Depth 1999	:	
• Ground Water Depth 1998	:	
• Arsenic Level by Thana	:	Derived from the British Geological Well Survey
• Nat_survey_well_d_arsenic	:	Interpolated data for arsenic concentration and well depth from well database pr
• Arsenic_nat_survey_wells	:	National survey of wells with data on arsenic, depth, many other elements.
• Major Rivers	:	Major Rivers of Bangladesh
• Water Bodies 1997	:	Water bodies
Agricultural		
• Foodgrain Status-District 1999-00	:	District-wise Foodgrain Status of Bangladesh (1999-2000)
• Foodgrain Status-Thana 1999-00	:	Thana-wise Foodgrain Status of Bangladesh (1999-2000)
• Cereal Area and Prod 2001-02	:	
• Foodgrain Status-Thana 2001-02	:	District-wise Foodgrain surplus and deficit (2001-2002)
• Cereal Area and Prod 1998-99	:	

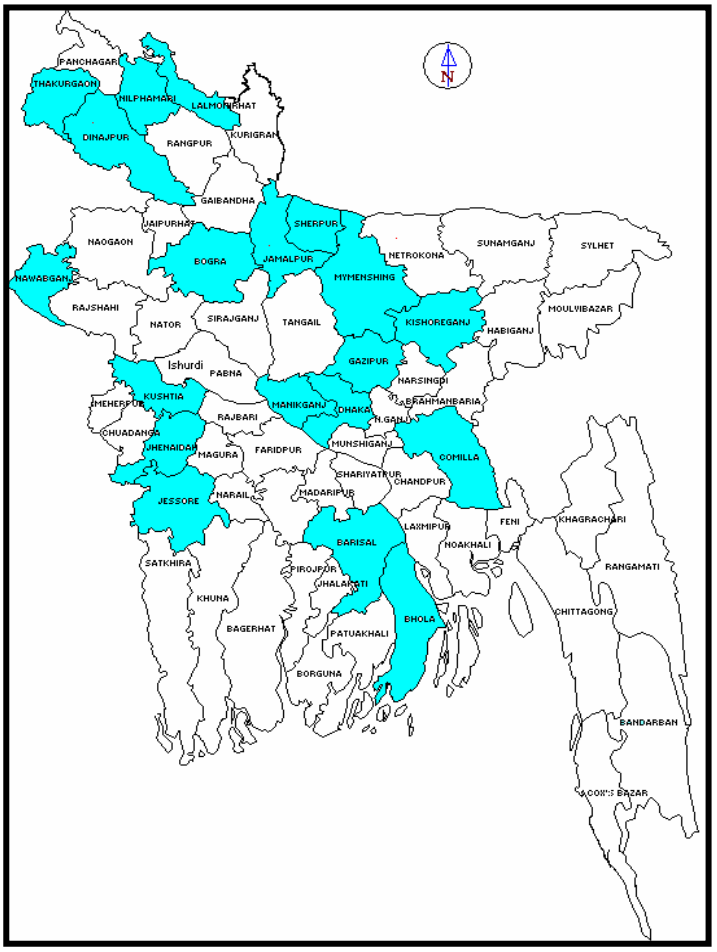
Elements/Data Layers		**Description of the Variables**
• Cereal Area and Prod 1999-00	:	
• Cereal Area and Prod 2000-01	:	
• Cereal Area and Prod 2002-03	:	
• Boro Growing Status	:	District-wise Boro rice Area(ha), Production(MT) and Yield(T/ha) (2000-2002)
• Aus Growing Status	:	District-wise Aus rice Area(ha), Production(MT) and Yield(T/ha) (2000-2002)
• Aman Growing Status	:	District-wise Aman rice Area(ha), Production(MT) and Yield(T/ha) (2000-2002)
• Wheat Growing Status	:	District-wise Area (hectares), Production
	:	(Metric tons) and Yield (t/ha) of Whea
• Maize Growing Status		District-wise Area(ha), production(MT) and
	:	yield(T/ha) of Maize
• Potato Growing Status	:	District-wise Area (hectares), Production
	:	(Metric tons) and Yield (t/ha) of Potato
• Dominant Cropping Pattern	:	Dominant Cropping Patterns of Bangladesh
• Suitable_Area_BR3	:	Suitable area coverage for BR3 rice
• Suitable_Area_BR14	:	Suitable area coverage for BR14 rice
• Suitable_Area_BR28	:	Suitable area coverage for BR28 rice
• Suitable_Area_BR29	:	Suitable area coverage for BR29 rice
• Suitable_Area_BR36	:	Suitable area coverage for BR36 rice
• Suitable_ Area_Aman	:	Aman suitability area of Bangladesh
• Suitable_ Area_Boro	:	Boro suitability area of Bangladesh
• Suitable_ Area_Aus	:	Aus suitability area of Bangladesh
• Suitable_Area_Wheat	:	Wheat suitability area of Bangladesh
• Suitable_ Area_Jute	:	Jute suitability area of Bangladesh
• Int Rice Sites	:	Sites reported by IRRI as having served as test sites for international rice
• Int. Maize Sites	:	Sites reported by CIMMYT as having served as test sites for international maize
		Sites reported by CIMMYT as having served as test sites for international wheat
• Int. Wheat Sites	:	Locations of Research Infrastructures of the National Agricultural Research System
Topographic		
• **DEM**		Digital elevation data for Bangladesh. It is 1km * 1km scale. derived from the S
Climatic		
• Temperature (deg C)		Temperature surface of long-term monthly average
• Windspeed (km/day)		Windspeed surface of long-term monthly average
• Sunshine (hours/day)		Sunshine surface of long-term monthly average
• Precipitation (mm)		Precipitation surface of long-term monthly average
• Humidity (%)		Humidity surface of long-term monthly average
• Solar-radiation		Solar radiation (MJ/m^2/day) surface of long-term monthly average

Elements/Data Layers		Description of the Variables
• Potential Evapotranspiration		Potential evapotranspiration surface of long-term monthly average
• Long Term Normals		Climatic surfaces created based on Long-term monthly average data of 30 Bangladesh Meteorology Department stations and 18 international stations
• Monthly Average Climatic data		Long-term monthly average computed for 30 Bangladesh Meteorology Department stations and for 18 international stations from FAO-Cropwat Ver. 7.0
Irrigation		
• Irrigation Equipment and Coverage 1999-2001		
• DTW Status 1999-2000		
• Irrigation Crop Coverage 1999-2000		
• No of Irrigation Equipment by Year		
• Irrigation by Power Source 1999-2000		
Images		
• Landsat Image		Landsat image of area around Dhaka from early 1990's
Poverty		
• Income Inequality and Poverty	:	Based on HH income for 5% sample of 2001 Population Census HH, using predictor regression model developed using 62-village survey of 1888 HH in 2001
• Demography	:	Based on HH data, 2001 Population Census (5% EA sample) & population data from 1991 and 2001 Population Census, Bangladesh Bureau of Statistics
• Labor Resources	:	Based on HH data, 2001 Population Census (5% EA sample) Bangladesh Bureau of Statistics
• Education	:	Based on HH data, 2001 Population Census (5% EA sample) Bangladesh Bureau of Statistics
• Land, Ownership & Tenancy	:	Based on 1996 Agriculture Census, Bangladesh Bureau of Statistics, 2000
• Agricultural Land Use	:	Based on 1996 Agriculture Census, Bangladesh Bureau of Statistics, 2000
• Livestock	:	Based on 1996 Agriculture Census, Bangladesh Bureau of Statistics, 2000
• Non-farm Assets	:	Based on 1996 Agriculture Census, Bangladesh Bureau of Statistics, 2000
• Infrastructure	:	Based on HH data, 2001 Population Census (5% EA sample) Bangladesh Bureau of Statistics,
• Natural Resources	:	Based on AEZ-GIS Database-Bangladesh Agricultural Research Council, BARC/UNDP/FAO GIS Project: BGD/95/006
• Agro-climate Maximum temperature	:	Calculation of median and 95% probability of weekly temperature data is done using long term

Elements/Data Layers		**Description of the Variables**
		average of 30 meteorological stations data of Bangladesh
• Agroclimate Minimum temperature	:	Calculation of median and 95% probability of weekly temperature data is done using long term average of 30 meteorological stations data of Bangladesh
• Edaphic Suitability	:	Classification of edaphic suitability by crop is based on Zijsvelt rules (1985); Soil-Crop suitability Classification for Bangladesh

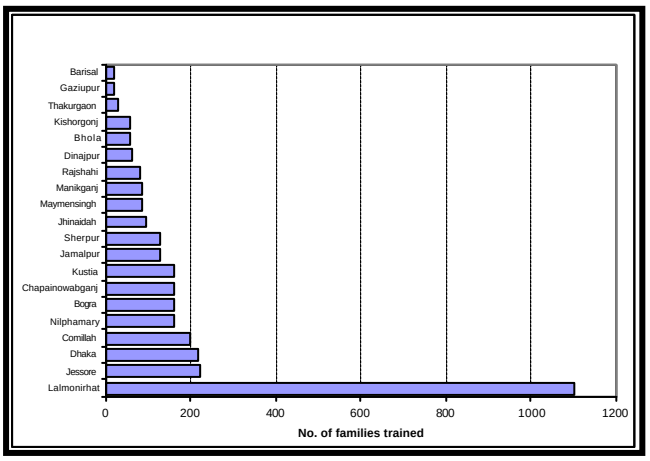
Whole Family Training in Maize

Introduction



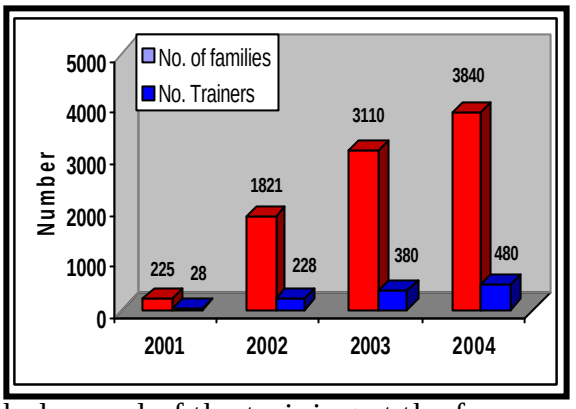
'Whole Family Training' is a gender unbiased participatory technology transfer system which has proved to be effective in disseminating wheat production technologies. It has also been proposed and tested for modern maize production technology transfer. The concept is designed to be comprehensible to and appropriate for the more marginalized maize growing families, providing agronomic options for the growers, obtaining feedback, and expanding options developed by the growers into the curriculum of the course. Field workers from non-governmental and governmental organizations, who routinely worked with maize growing families in other capacities, are instructed on the 'Whole Family technologies and methodologies', so that they, in turn, could train their clientele. The figure on the right represents the whole family training sites. Details of the activities are described in the following sections:

Whole family training (WFT)



Through planning meetings, CIMMYT Bangladesh, GOB and NGO partners decided to conduct whole family training among 3,236 maize farm families (12,944 maize growers) on modern maize cultivation. Hundred percent of the targeted families were trained throughout the country. The figure on the left side depicts district-wise family distribution under the maize whole family training program.

Figure on the right shows year-wise achievement of family numbers and trainers trained on modern maize cultivation practices since 2001-02 to 2003-04 and the proposed number of families and trainers to be trained during 2004-05.



In the proposed plan of action each year, 1,000 families were targeted for training. Due to high demand of the training at the farm level and also demand placed by the partners—both private and governmental organization, CIMMYT-Bangladesh and GOB partners agreed to increase the numbers from 1,000 families to 3236 families. For conducting additional number of family training, partners and CIMMYT-Bangladesh decided to share the budget allocated for demonstration purposes. Moreover, a private entrepreneur, Doel Agro Industrial Complex Ltd. shared partial cost for the training of their 300 families and few demonstrations. To train the whole families, 405 trainers from the Department of Agricultural Extension (DAE), NGOs and Doel Agro Industries Ltd. were trained on the whole family concept and modern maize cultivation practices by CIMMYT and NARS scientists. A typical training of trainers (above) and a whole family training session (right) are illustrated.

A Session of Trainers Training

A Session of Whole Family Training

Training material preparation and distribution

For training purposes, the following materials were prepared and distributed to partners, farmers, NARS institutions, development agencies, universities, private entrepreneur and seed companies:

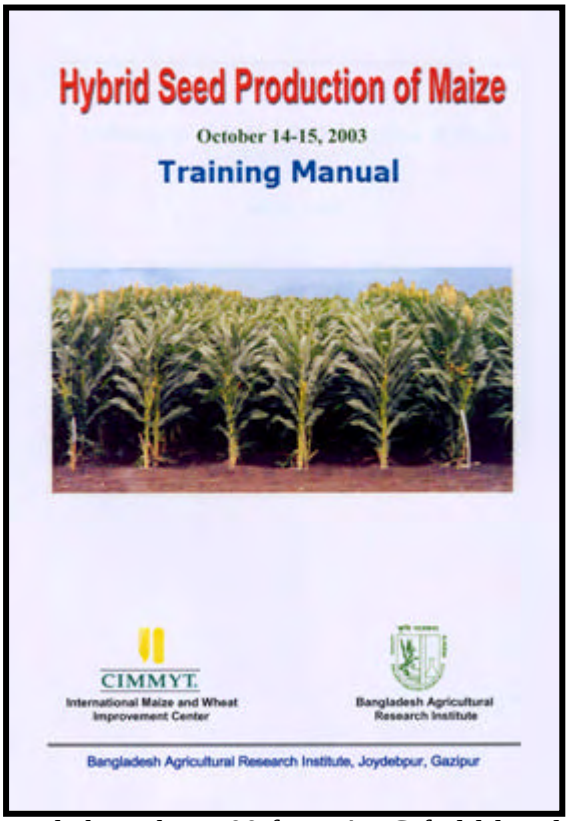
- 8,000 sets of modern maize production manual in Bengali including multicolored pictures and text. The cover page of the manual is illustrated in the figure of right side.
- 150 sets of large-size multicolored pictorial posters

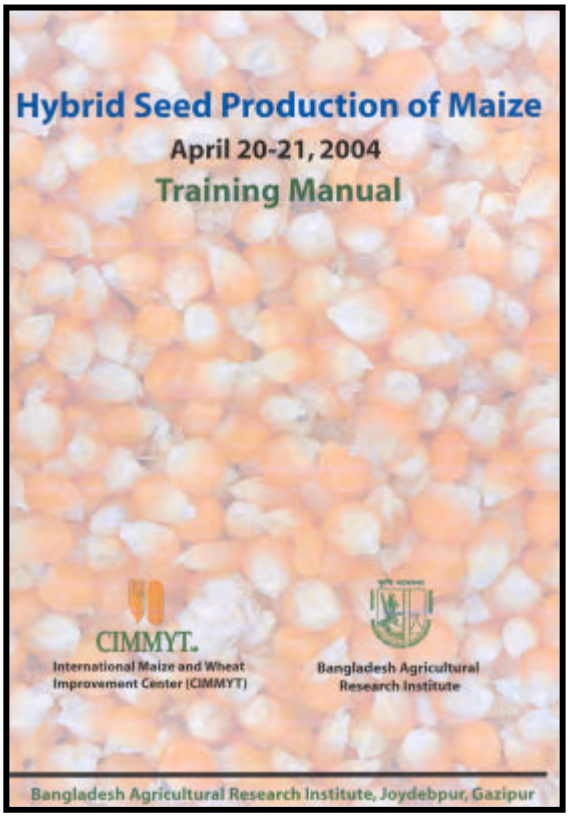
A cover page of maize whole family training manual

- 300 nos. modern maize cultivation.

Hybrid maize seed production training manual preparation and distribution

A total of 35 mid and senior level officers and 25 field level technicians of Bangladesh Agricultural Development Corporation (BADC) were trained on maize hybrid seed production practices at the Bangladesh Agricultural Research Institute. Two training manuals, one for mid and senior level officers and the other for field level technicians were produced by CIMMYT Bangladesh (copies available on request). Two hundred training manuals, 100 for BADC mid and senior level officers



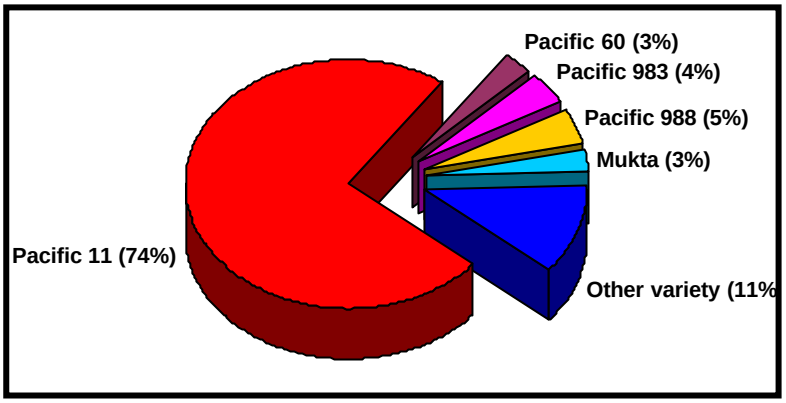


and the other 100 for BADC field level technicians were printed out and distributed to trainees, trainers, research institutions, universities and agricultural training institutes of the Department of Agricultural Extension. The cover pages of the training manuals are depicted in the figures above.

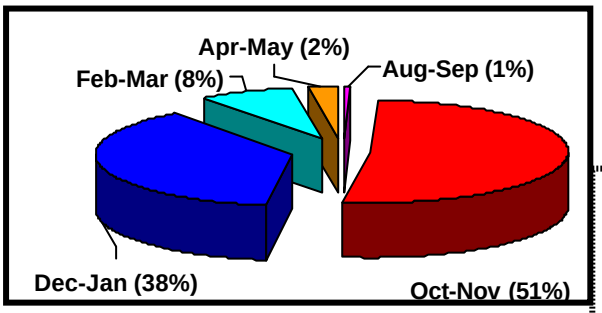
Pre-assessment of farmers' maize cultivation knowledge

Three thousand maize farm families were surveyed through structured questionnaire for assessing pre-training maize cultivation knowledge. Surveyed data were analyzed on the selected parameters and the results are highlighted bellow:

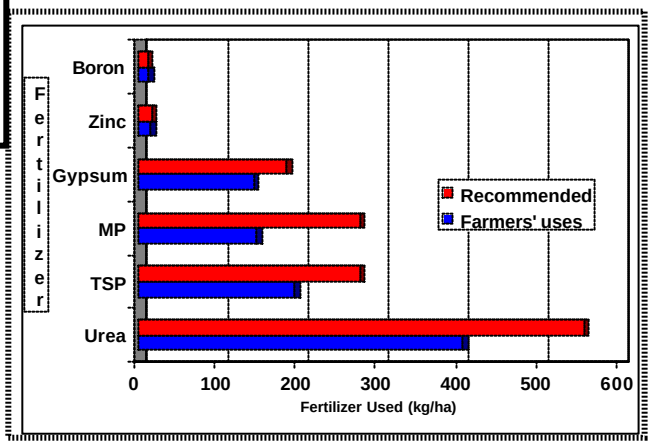
- 74% of the respondent reported growing Pacific-11, a well adopted double cross hybrid maize variety. The rest reported cultivating Pacific-988 (5%), Pacific-983 (4%), Pacific-60 (3%), Mukta (3%) and other non-named varieties (11%).

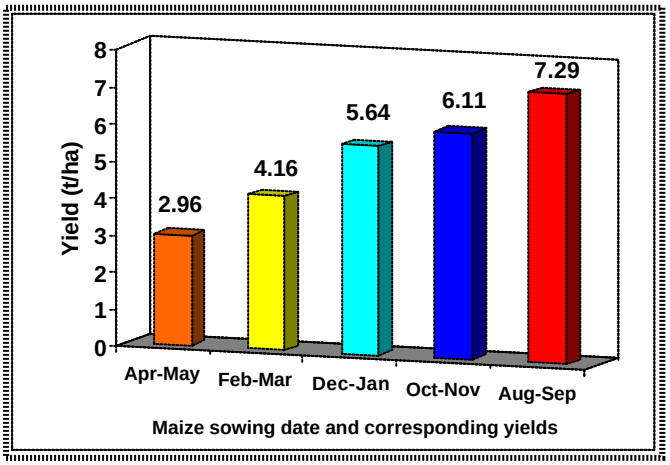


- More than 50% respondents reported planting maize during the month of October -November and followed by December-January planting. A small percentage of farmers also planted maize during February-March, April-May, and August-September



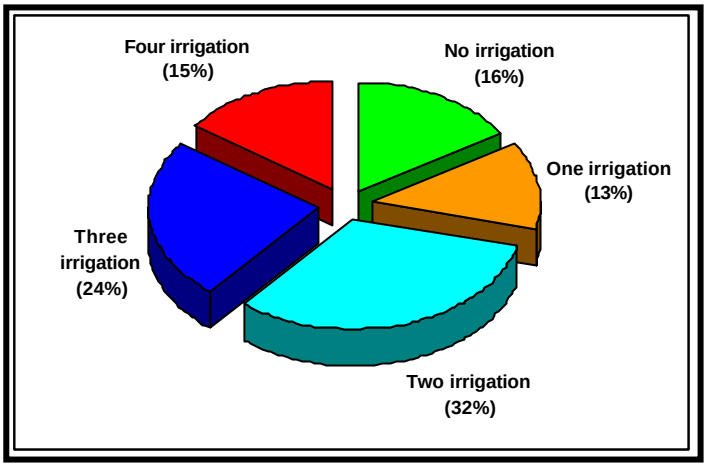
- Surveyed farmers used less than recommended fertilizers, Urea, TSP, MP, Gypsum, Zinc and Boron in maize cultivation. Figure on the right illustrates the farmers' fertilizer use and recommended fertilizer rate for maize cultivation.



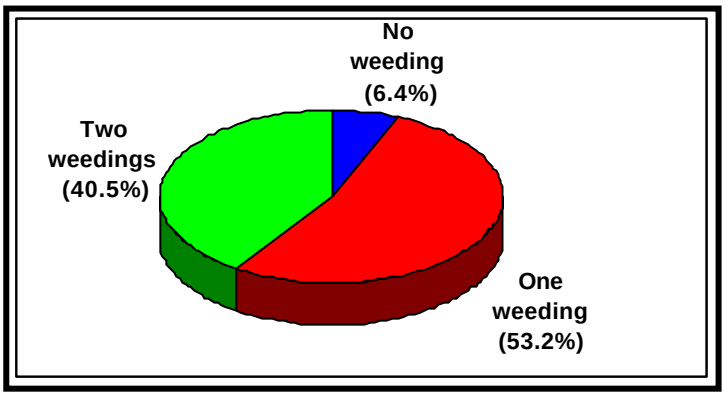


- Survey data showed that maize grain yields were more than 7 t/ha in August-September planting. Sowing beyond this month, the yields started to decline and the lowest yield was reported sown in April-May planting.

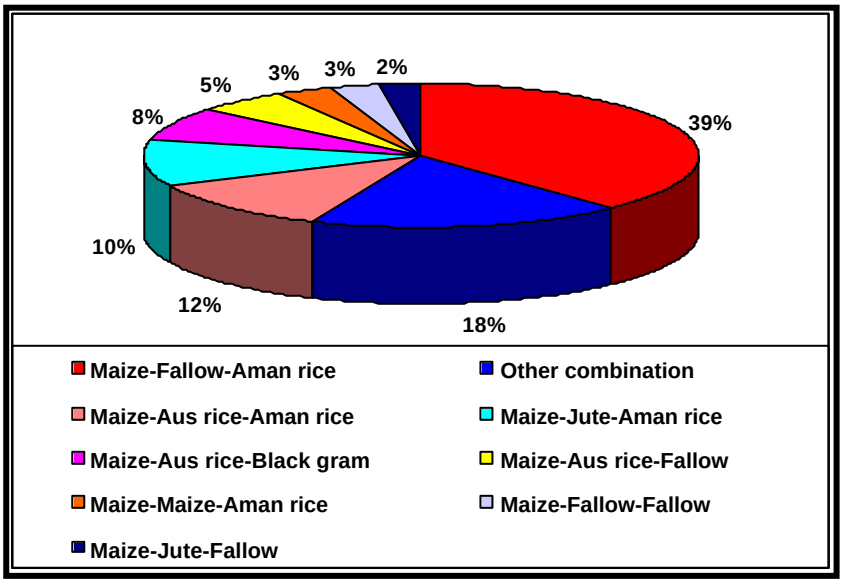
- About 32% farmers irrigated maize crop twice while only 25% reported irrigating maize crop 3 times during cropping season. Figure on the right showing the farmers irrigation application status for maize cultivation.



- Survey data show that maize fields were weeded once as reported by 52% farmers while 41% farmers weeded twice.



- Farmers planted maize at an average row-to-row distance of 28 inches and seed-to-seed distance 10 inches.
- Several maize-based cropping systems are being practiced by the surveyed farmers. Highest percent of farmers (more than 35) practiced maize-fallow-aman rice cropping system.



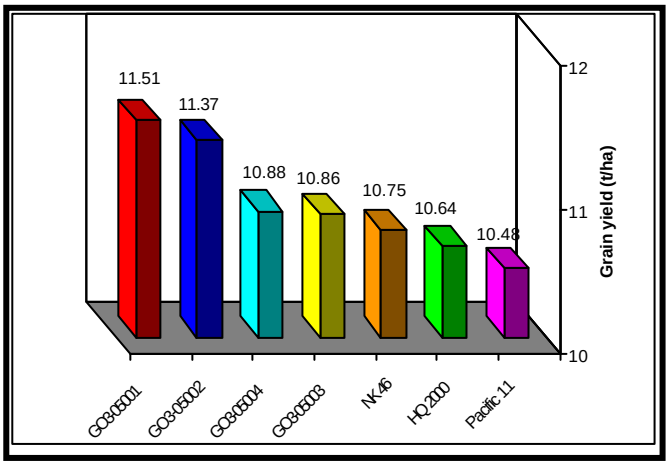
Demonstration

Demonstration of maize cultivation knowledge by the whole family trained farmers

A total of 3,236 participatory demonstrations were setup by the whole family trained farmers in their farms. From the project, each family was provided with 2 kg modern hybrid maize seed as an incentive while farmers provided other inputs, i.e., fertilizer, insecticides, land and labor. These demonstrations helped the trained farmers to apply their training knowledge in modern maize cultivation practices. The figure in the right shows a maize demonstration plot being managed by a whole family trained farmer.

Varietal demonstrations

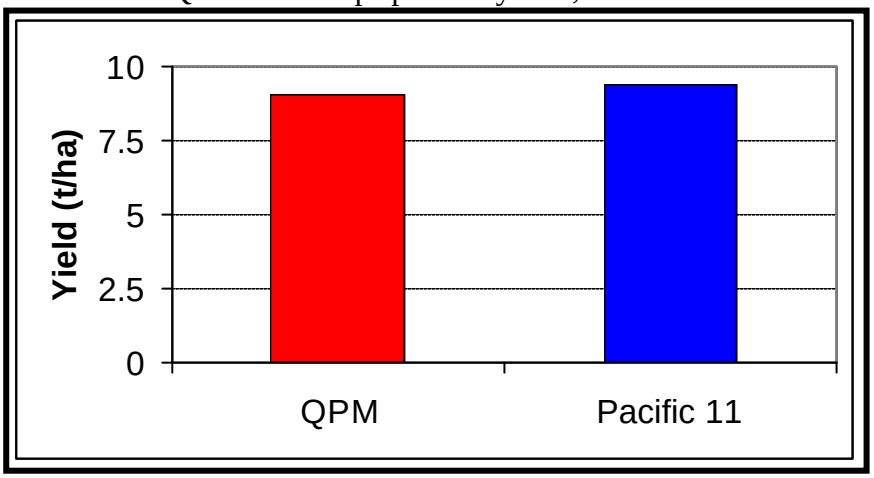
Sygenta, a private seed company imports seed of different hybrids and markets to maize growers. Before marketing the product, Sygenta provided CIMMYT five hybrid maize varieties this year for field evaluation and identification of the best performing varieties for commercial cultivation and marketing. The five hybrids along with a quality protein (QPM), HQ 2000 of Vietnam origin and a popularly grown commercial hybrid, Pacific 11 were tested through CIMMYT Partners, BARI at Joydebpur, Jamalpur, Jessore and Barisal regional stations under recommended management practices. The above left sided figure shows a varietal evaluation plot in Jamalpur and the right sided figure depicts productivity of the varieties. Evaluation tests



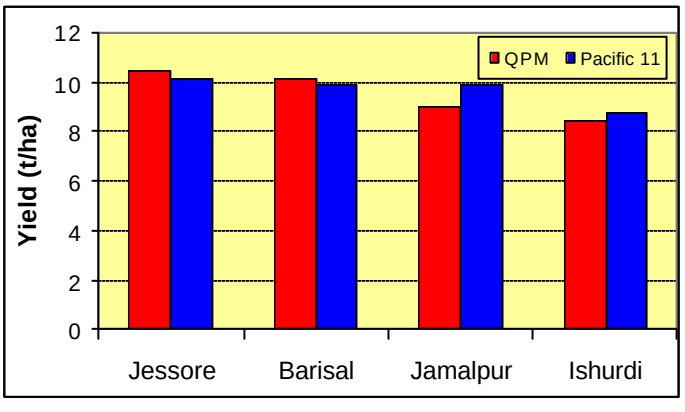
revealed that no disease infestation was seen among the varieties. All the tested varieties produced statistically comparable grain yield. Considering the grain yield, maturity, thousand grain weight, husk cover, grain type, colour of grain GO3-05001, GO3-05002 and HQ 2000 were identified as the best performing varieties for commercial cultivation across different regions of the country.

Quality protein maize (QPM) demonstration in multi location

QPM is a hybrid maize variety developed by CIMMYT, rich in essential amino acids like Lysine and Tryptophan. These two amino acids are very low in existing commercial maize hybrids being grown. Large scale cultivation of QPM and its use for poultry feed could reduce feed cost to a great extent. Therefore, adaptability and yield performances across the country are important. To evaluate the adaptability and yield performance across the different nine ecologies of this country, a multi-location trial was undertaken with QPM with a popular hybrid, Pacific 11 as check. The figure on the right side shows the mean productivity level of QPM and Pacific 11 varieties. Grain yield of QPM and Pacific 11 were similar (about 9 ton per ha) indicating the potentiality of the QPM hybrids cultivation along with other hybrid as poultry feed and human food in Bangladesh.



QPM (Var. HQ2000) production demonstration

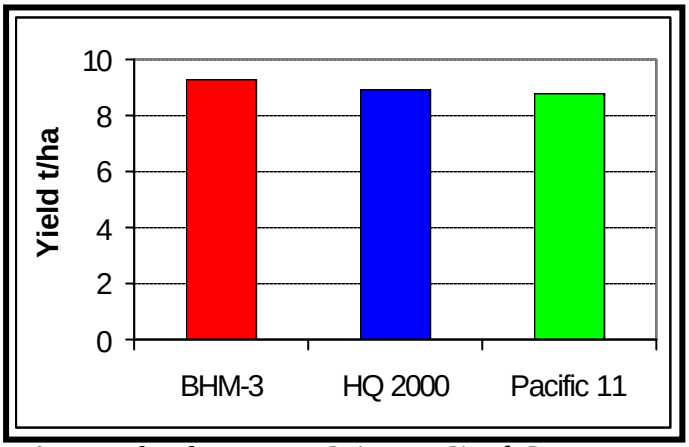


A production demonstration of Vietnam origin QPM hybrid (HQ 2000) was demonstrated along with the Pacific 11 in four production demonstration sites, Ishurdi, Jamalpur, Jessore and Barisal to evaluate grain yield level in large farm field conditions. Figure on the upper left shows a QPM field in Jamalpur. The grain yields data on the upper right side shows comparable production performance in all sites.

Thus, this suggests that QPM could be a potential maize variety in Bangladesh for commercial production and utilization in the poultry feed industry.

Production demonstration of BARI hybrid maize

For popularizing the BARI newly developed and released single cross hybrid maize,



BARI Hybrid Maize - 3 (BHM-3) of CIMMYT origin among the maize growers, seed traders, and seed producers, a production trial with BHM-3 along with HQ 2000 and Pacific 11 was conducted through CIMMYT partners, BARI and BRAC in five different agro ecological regions (Joydebpur, Ishurdi, Jamalpur, Jessore and Barisal) of the country. Figures on the upper left show BHM-3, HQ 2000 and Pacific 11 trials' mean productivity levels for these varieties and upper right photo depicts the BHM-3 maize plant with double cobs resulted higher productivity. The BHM-3 out yielded (9.2 t/ha) the HQ 2000 (8.9 t/ha) and Pacific 11 (8.8 t/ha) indicating the potentially of BHM 3 cultivation by farmers across the country. For promoting this variety, BARI produced 435 kg and 417 kg seed of its female and male parents, respectively and these are ready for distribution to BRAC, East West Center and BADC for seed production and marketing. In these activities, CIMMYT is providing technical and logistical support.

Quality protein maize (QPM) feeding trial demonstration

In collaboration with Bangladesh Livestock Research Institute (BLRI), CIMMYT has planned and setup three research demonstration trials to study the response of this QPM-based diet on broilers, layers, and goats compared to the existing commercial maize-based diet. For these trials, a total of 1 ton of each of QPM and commercial hybrid will be required and produced locally in farmers' field.

For making the quality feed, the manufacturers import synthetic Lysine and Tryptophon at the cost of huge foreign currency and resulting the feed price high. The higher cost of poultry feed could be lowered to a great extent if QPM hybrid maize is introduced and used in the poultry feed industry in Bangladesh. Till today, no studies have been done to determine the response of QPM hybrid on growth and development of poultry layer, broilers and goat in Bangladesh. Thus, CIMMYT and BLRI jointly design the research protocol and began the trial.

Feeding trial with goats

Results of the feeding trail with goats revealed that the effect of replacing normal maize (Pacific 11) by QPM (HQ 2000) had no beneficial effect on intake, digestibility, growth rate and feed efficiency of growing Black Bengal goat. Results obtained so far suggest that the QPM based diet was no better than Pacific 11 as an ingredient of concentrate mixture for growing goat. This was a predicted result as goats have a ruminant stomach and as such, can produce these amino acids through bacterial growth.

Feeding trial with broilers

Results of five weeks feeding trail with a day-old chicks revealed that their was no clear advantage of QPM over normal maize (purchase from market) or Pacific 11 in terms of total gain in body weight, feed intake, feed conversion and mortality. More trials are needed to make valid conclusions about the replacement of normal maize by QPM.

Feeding trail with layers

QPM base diet performed similarly with the control diet in terms of egg weight, egg production, yolk color and breaking strength. Moreover, it appears from the study that there is no need to use lysine and metheonine in both QPM and normal maize based diet. However, it needs further trials to arrive at a valid conclusion

Tortilla (bread) making machine demonstration

Years of training of Bangladeshi maize and wheat Breeders to CIMMYT Mexico impacted them to motivate for the importation of a commercial Tortilla machine for maize use and diet diversification as human food. CIMMYT imported Tortilla machine and leased out to partner NGO, Bangladesh Rural Advancement Committee (BRAC) for making and enhancing marketing Tortillas in the country.

The machine has been installed at Tongi, Gazipur and BRAC people have been trained on the tortilla preparation process, machine operation and maintenance. The machine can make 100 kg tortillas per hour or one tortilla per second. The above figures show that BRAC people are at work in tortilla making factory, making tortilla and packaging tortilla for marketing. BRAC is regularly monitoring and evaluating consumers' preferences at different level for better and sustainable tortilla marketing in Bangladesh.

Maize sheller demonstration

Two years on-farm demonstration of CIMMYT-BARI developed Maize Sheller (1.5 ton per ha capacity) at maize whole family training sites, Sherpur, Jamalpur districts by maize scientists of RARS Jamalpur convinced maize farmers the necessity to use a maize sheller to quickly shell maize, saving labour, and creating good maize quality to be marketed at a higher price. In 2004, farmers procured three power sheller from Mahbub Engineering, Jamalpur and are expected to procure 10-15 of such units in the next year.

Furthermore, two power-shellers have been sold to maize farmers at Fulbari, Dinajpur in collaboration of CIMMYT BHT program.

Newly developed power maize sheller

Maize germplasms importation and distribution

CIMMYT Bangladesh received 7 exotic inbreed and 101 hybrids materials from Mexico and distributed to CIMMYT partners, BARI and BRAC for evaluation and selection of the best entries from each trial set for using in the breeding program for the development of new hybrids. The table in the right show number of entries imported from each trial and number of potential entries selected through experimental trial for further advancement for hybrid development.

Name of Trials	No. of entries evaluated	Name of potential entries selected	Remarks
CHTHIY 2003	18	None	-
TTWCEY 2003	29	CMS 991008 CMT 031021 CMT 011048	Selected 3 entries out yielded the local check
CHTTEY 2003	12	CMT 011012 CMT 011018 CMT 011044	Selected 3 entries out yielded the local check
CHTSYQ 2003	14	E 7 E 11	Selected 2 entries out yielded the local check
CHTSY 2003	10	E 7	Selected 1 entries out yielded the local check
CHTTWQ	18	CMSQ 013013 CMSQ 013023	Selected 2 entries out yielded the local check

Evaluation of imported hybrid maize varieties of seed companies

Seed companies and NGOs i.e., United Seed Store, Supreme Seed, Siddique Seed and BRAC requested CIMMYT for evaluation of their imported hybrids. Twenty-six hybrids were evaluated by CIMMYT's partner, BARI at their farm in Gazipur. Considering grain yields and other yield attributes, Pacific 747, Pacific 759 and HQ 2000 performed the best.

Whole family training concept expanded

Through interaction, discussion and meetings with CIMMYT scientists on Whole Family Training concept, Winrock International, World Fish and Northwest Crop Diversification Program (NCDP) of DAE found the WFT concept very effective in transferring their technologies with cliental groups.

Winrock International for its BREAD-II project and DAE in their NCDP project for maize promotion adopted this approach through sharing CIMMYT training maize cultivation.

World Fish has used this concept in the light of their objective for community fish promotion and development activities of their target areas.

Monitoring farmers' field, demonstration and experimental plots

During 2004-04, CIMMYT and NARS scientists frequently visited trained farmers' fields, demonstration and experimental plots. During their visit, maize scientists observed field level problems and suggested on the spot remedy of the problems. It was also observed that the trained farmers applied their training knowledge for maize cultivation and indigenous knowledge for intensifying maize based systems through intercropping potato and short growing leafy vegetable, like red amaranth (lalshak), reddish and palonkshak. A few practices are illustrated in the following pictures.

Trained Farmers Applied the Knowledge of Growing Excess Seedlings for Gap Filling - An Important Factor for Higher Yields

Field monitoring

Maize based intercropping system

Maize+potato and maize + red amaranth intercropping system have been found ergonomically and economically productive among the whole family training farmers as the intercrop did not affect the maize crop yield and earned additional Tk. 30,000 in case of potato and Tk. 14,000 incase of red amaranth per ha.

Experimental Plot monitoring

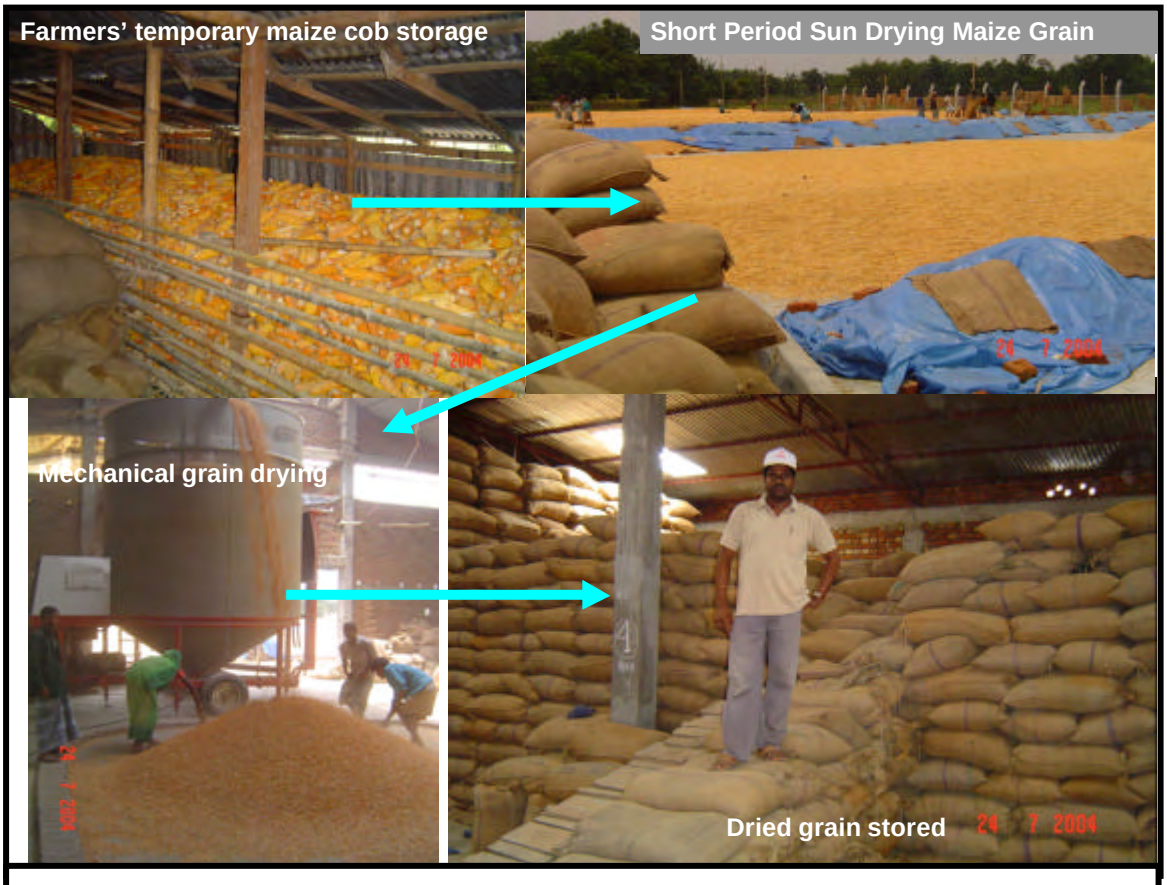
CIMMYT Scientists during their field visits appreciated the NARS Scientists breeding program for developing better hybrids adapted to local conditions.

CIMMYT senior maize breeders with NARS maize breeders in the field

CIMMYT scientist from HQ (right) and regional scientist Nepal (left) are happy to see new hybrid being developed by a young BARI maize breeder (middle)

Comparison of whole family trained farmers' maize plot with non-trained farmer's plot

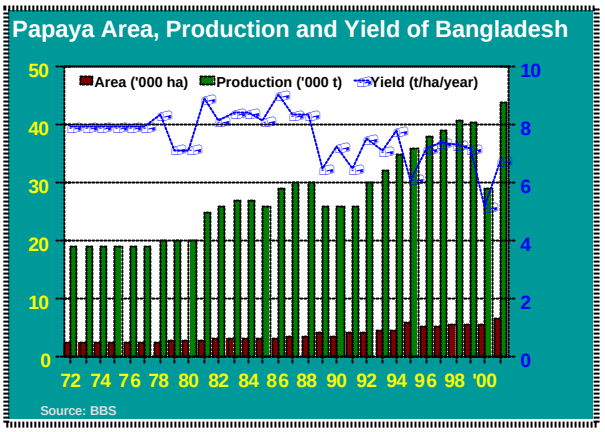
Trained Farmer in His Good Crop Field **Non-Trained Farmer with His Poor Crop field**



CIMMYT Technical Assistance to Doel Agro Industrial Complex Ltd. Helped to Establish a Complete Agro Based Maize Industry at North-West corner of Bangladesh, Patgram, Lalmonirhat

Development of Ring spot Virus Resistant Transgenic Papaya for Bangladesh

The popular crop papaya is well recognized as both a vegetable and fruit in the country. Commercially it is a viable crop raised in homesteads and farmlands. The fruits are very nutritive having rich in vitamin A and vitamin C which are important for meeting the nutritional deficiencies of the general mass of people in this country.



The current production of papaya has deteriorated due to infestation of the devastating disease PRSV in papaya (see figure below). The disease is a great problem in papaya production in respect to yield reduction and quality of fruit. To address this problem, the improvement of papaya is urgently required trough development of PRSV tolerant varieties in Bangladesh. Use of traditional or conventional breeding techniques has largely failed throughout the world. Thus, the use of transgenics, which has been successful in the USA for PRSV resistance, will be implemented here in this program. With in view, certain activities have been undertaken during the past year.

Survey on the strains of PRSV-P in Bangladesh


Virus affected papaya

A survey was conducted based on symptoms to find out the variants/ strains of PRSV-P. In all 400 samples were collected as representatives of different regions in Bangladesh. These collected samples were preserved on silica gel in plastic petri -dishes as well as glass vials. These will be sent to USDA, Hawaii in July 2004 (with proper permits) for testing by bioassy and PCR. Finally the strains of PRSV-P will be determined and accordingly the coat protein (CP) will be identified and tested for homology with other strains of the CP gene. The coat protein gene of the strain(s) will be inserted in papaya plants (Shahi Bangladesh variety) to develop transgenic plants to control the

severe strains of PRSV. However, the samples will be tested by bioassy in Bangladesh if and when the GOB has approved of the process.

Status of papaya variety(s)/ line(s) against PRSV-P

The available papaya variety(s)/ line(s) available at BARI have been planted in BSMRAU campus experimental field for testing about PRSP-P through mechanical inoculation. The natural occurrence of PRSV-P will also be determined simultaneously. The activities will be performed through active collaboration between BARI and BSMRAU.

Work on regulatory and Bio-safety

Various formal and informal meetings were organized during the period under review with many of the partners interested in implementing transgenics. The document on regulatory and biosafety is still in the Ministry of Environment to onward transmission for approval at national level.
Drs. M A Razzaque and Craig A Meisner of CIMMYT Bangladesh presented papers to the Annual General Meeting of Bangladesh Plant Genetics and Breeding Society on Biotechnology, Biosafety and Transgenic Papaya at the Bangladesh Agricultural University, Mymensingh. ABSP-II was provided an office space at the CIMMYT office and we regularly communicate, collaborate and coordinate our activities. ABSP-II organized the agricultural biotechnology certificate course from April 17-23, 2004 in Goa, India. Fourteen Bangladeshi participants from different ministries, NARS, institutions, BARC, private sectors etc. attended the training course.

Net houses in Joydebpur and Ishurdi under BARI have been renovated for testing and acceptance of any transgenic papaya and other materials brought to Bangladesh according to the rules Gazette by the parliament for biosafety. They are ready now if the GOB approves transgenic papaya for field testing.

Help to GOB for implement intellectual property rights

Executive Chairman BARC has planned to visit Cornell University and Washington DC in July 2004 to see the biotechnological interventions and attend the Board Meeting of ABSP II respectively. The Minister of Agriculture, the EC of BARC, the MD Crops of BARC and the Director of Wheat BARI were invited by the Director General of CIMMYT to visit CIMMYT HQ as well as the USDA lab in Hilo Hawaii. However, the MoA was not able to go in September as planned. We may perhaps make this at another time.

Also Drs. M A Razzaque of BARC and Craig Meisner of CIMMYT have planned to USDA in September, 2004 to learn about the IP and transgenic capabilities/possibilities for exchange of materials directly in addition to the originally planned transformation of indigenous of Bangladeshi Papaya.

Significant progress in USDA lab in Hillo Hawaii

Dr. Savarni Tripathi and other research associates in India (now at the USDA Lab in Hilo Hawaii) found (in the gene bank) the coat protein gene sequence of a PRSV isolate from Bangladesh. In comparing the sequences he found that the sequences are quite far different from those of Thailand (86%), Taiwan (87%), and also Hawaii (89%).

Interestingly the Hawaii isolate has the highest homology to the Bangladesh strain. The sequence information was obtained from Dr. Jain of India. It might be that the synthetic genes that have been designed by USDA for papaya might be the easiest way to getting broad resistance in the isolates. However, checking of the gene constructs has been initiated to start transformation experiments soon.

Dr. Manan Akhanda, Professor of Plant Virology of the Bangobhandu Sheik Mujibar Rahman Agriculture University, departed in July for a 6-month stint at the USDA Lab in Hilo Hawaii. He will work closely with Dr. Dennis Gonsalves, the Principle Investigator of this program there at his lab in Hilo Hawaii. Other virologists from other nations are also working with Dennis during the next 6 months.

Impact of Arsenic Contamination on Agricultural Sustainability and Food Quality

The Arsenic Research Program: Objectives and Partners

There is a growing national concern about arsenic contamination of ground water, especially because many millions of people in Bangladesh face a two-way risk of exposure to arsenic, directly through drinking water and indirectly through food crops grown arsenic contamination of soils from contaminated irrigation water. About 1,400 metric tons of arsenic is estimated to be brought up by irrigation tube wells and deposited on agricultural soils each year which is polluting the soils and ultimately the crops grown on these soils. There is an urgent need for an understanding of the nature and extent of arsenic pollution of the irrigation waters, soils and crops of Bangladesh and developing water-soil-crop management practices to mitigate the arsenic problem in Bangladesh agriculture and food. CIMMYT Bangladesh, in collaboration with national and international partners, has been working on the arsenic contamination issue for the last two years.

A R&D program was initiated in early 2002 with four national and three international partners with the following major objectives:

- National capacity building to enable the Bangladeshi agricultural research institutions and scientists to conduct R&D work on As in agriculture.
- Evaluation of the impact of As contamination in water and soils on crop productivity and quality.
- Understanding the chemistry and mineralogy of As in soils as they relate to the uptake and accumulation of the element in crops.
- Development of water-soil-crop management practices to manage the Ass problem in crop production systems and reduce the As load on the food chain.

National partners

- Bangladesh Agricultural Research Institute (BARI)
- Bangladesh Rice Research Institute (BRRI):
- Bangladesh Institute of Nuclear Agriculture (BINA)
- Bangladesh Agricultural University (BAU)

International partners

- Cornell University (CU), USA: Prof. John M. Duxbury
- Texas A&M University (TAMU), USA: Prof. Richard H. Loeppert
- International Maize and Wheat Improvement Center (CIMMYT): Dr. Craig A. Meisner

During the years, scientists of the Bangladeshi national partner institutions conducted field surveys and experiments (in Bangladesh, as planned) and carried

out laboratory analyses for As and other relevant elements in STW irrigation waters, soils and rice plants. The international partners, CU and TAMU, helped install and optimize hydride generation (HG) units for the atomic absorption spectrophotometers (AAS) in the laboratories of the national partner institutions and provided training for Bangladeshi scientists and laboratory technicians on the use of the HG-AAS set-up for the analysis of As in water, soil and plant samples. In addition, CU and TAMU did the advanced chemical and mineralogical analyses and performed cross checking of analytical results for quality control. CIMMYT, through its Bangladesh office, did its share of the job by: (1) facilitating and coordinating program activities by the national partners and providing technical assistance, (2) maintaining liaison with the two other international partners, CU and TAMU, and (3) facilitating exchange of information and material between the national and international partners.

Arsenic in the Water-Soil-Plant System: Survey and Assessment

In the first year (2002-2003) five *thanas* (smallest administrative units): Brahmanbaria, Senbag, Faridpur, Paba and Tala representing diverse physiographic and hydrological situations in the eastern, central and western districts of Bangladesh were selected for an As survey-assessment study. The results were reported last year.

Evidence of elevated arsenic concentrations in irrigation water, soils and rice were obtained. Complex soil mineralogical compositions, which could variously affect As sorption-desorption and mobility were indeed found. All the soils contained poorly crystalline and well-crystalline Fe-oxides but the amounts and ratios were highly variable. Additionally, the soil As contents correlated poorly with the soil Fe-oxides. Other natural factors like flooding and siltation, and anthropogenic factors like cropping systems and sequences, water management, tillage, etc. may individually and interactively influence As in the environment.

In the second year (2003-04), emphasis was given on a nationwide survey to assess the arsenic situation in 184 unions in 92 thanas all over the country. The sampling protocol used is described in the following:

A. Selection of sampling locations

1. The country was hypothetically divided into 7 Hydrological Regions (HR) on the basis of river network (Fig.1, Source: National Water Management Plan Project, Development Strategy Report, WARPO, 2002). To develop a database on soil, water (ground water) and plants, only those thanas having ground water irrigation tube wells particularly, shallow tube wells (STW) were considered. Thanas in the south-eastern hill areas, the metropolitan thanas and thanas representing non-agricultural land in the coastal region of Bangladesh were excluded.
2. Each HR was divided into 15 km grids as in Fig. 2. Starting from the thana located in the central grid, thanas located in the alternate grids were selected

as the "site" thanas. After locating the thanas in all HRs, thanas located at the border of the HRs were reselected (if necessary) such that no two thanas would have a common border.

3. Two unions were selected at random from each thana using a spatial sampling tool of AWhereACT, the GIS tool of Bangladesh Country Almanac (BCA).

B. Sampling strategy

1. The sampler took water, soil and plant (rice / non-rice) samples from the fields within the command area of selected STWs (rice) and from fields outside the STW command area where non-rice crops are grown. The selected thanas and unions are shown in Fig. 3.
2. From the command area of each selected STW, soil and water samples were collected from one spot---- from the middle of the rice field nearest the STW. Soil samples were collected from 3 layers: 0-15cm, 15-30cm and 30-60cm. About 500 g soil sample were collected from each layer.
3. Separate soil (depth-wise as above) and plant samples were collected from a field outside the STW command area to represent non-irrigated soils and non-rice crops.
4. For rice, both grain and straw samples will be collected for EACH variety grown in the command area. For non-rice, samples of edible plant parts (EACH crop grown) will be collected. At least 200 g rice grain sample, 500 g rice straw sample, 500 g non-rice crop sample (green weight basis) should be collected. RICE CULTIVAR NAMES WERE RECORDED.
5. Information, such as, depth and age of the STW, size of the of its command area, cropping pattern, land type, etc of the sampling fields will also be recorded.
6. ALL SAMPLING POINTS MUST BE GEO-REFERENCED USING GPS.
4. Statistics of the sampling units are presented in Table 1.

Table 1. Summary statistics of sampling units.

Hydr. Regions	Total thanas	Sampling thanas	No. of selected thanas	No. of selected unions	No. of STWs
NW	124	119	26	52	52
NC	83	66	15	30	30
NE	63	57	15	30	30
SW	78	67	15	30	30
SC	50	23	7	14	14
SE	40	39	9	18	18
EH	52	23	5	10	10
Total	**490**	**394**	**92**	**184**	**184**
Total no. of soil samples = 184 x 2 x 3 = 1,104					

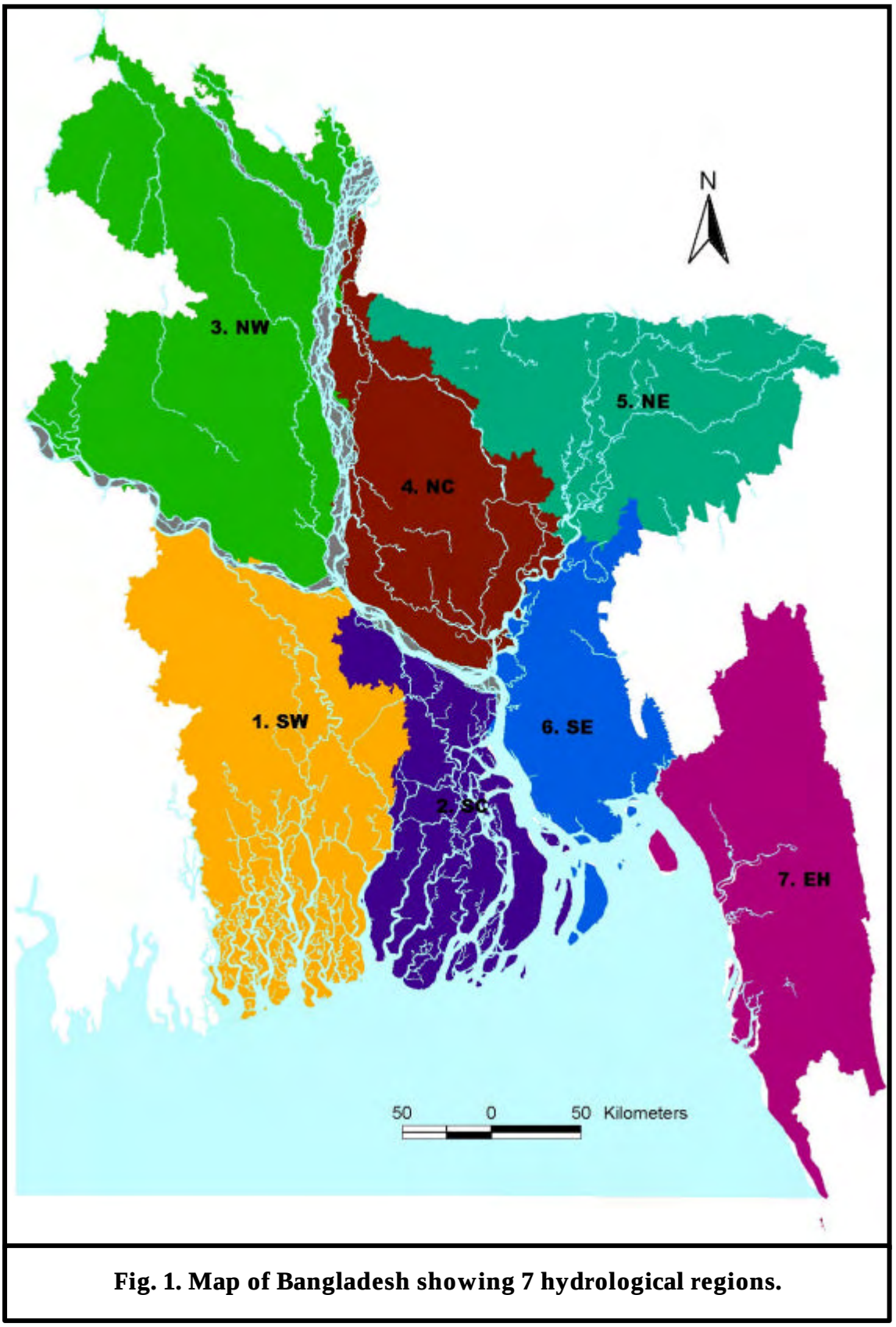


Fig. 1. Map of Bangladesh showing 7 hydrological regions.

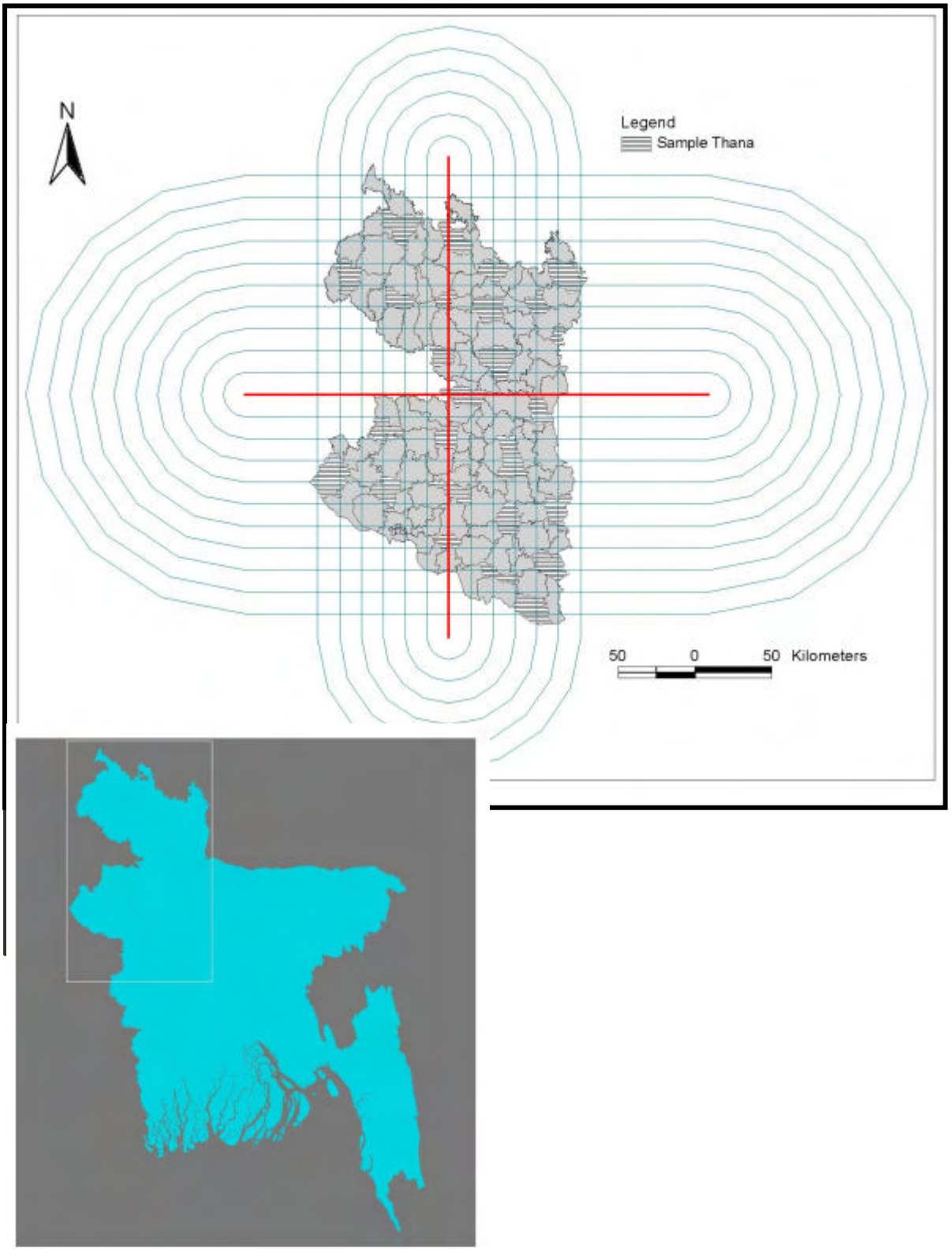


Fig. 2. Selection procedure for sample Thana

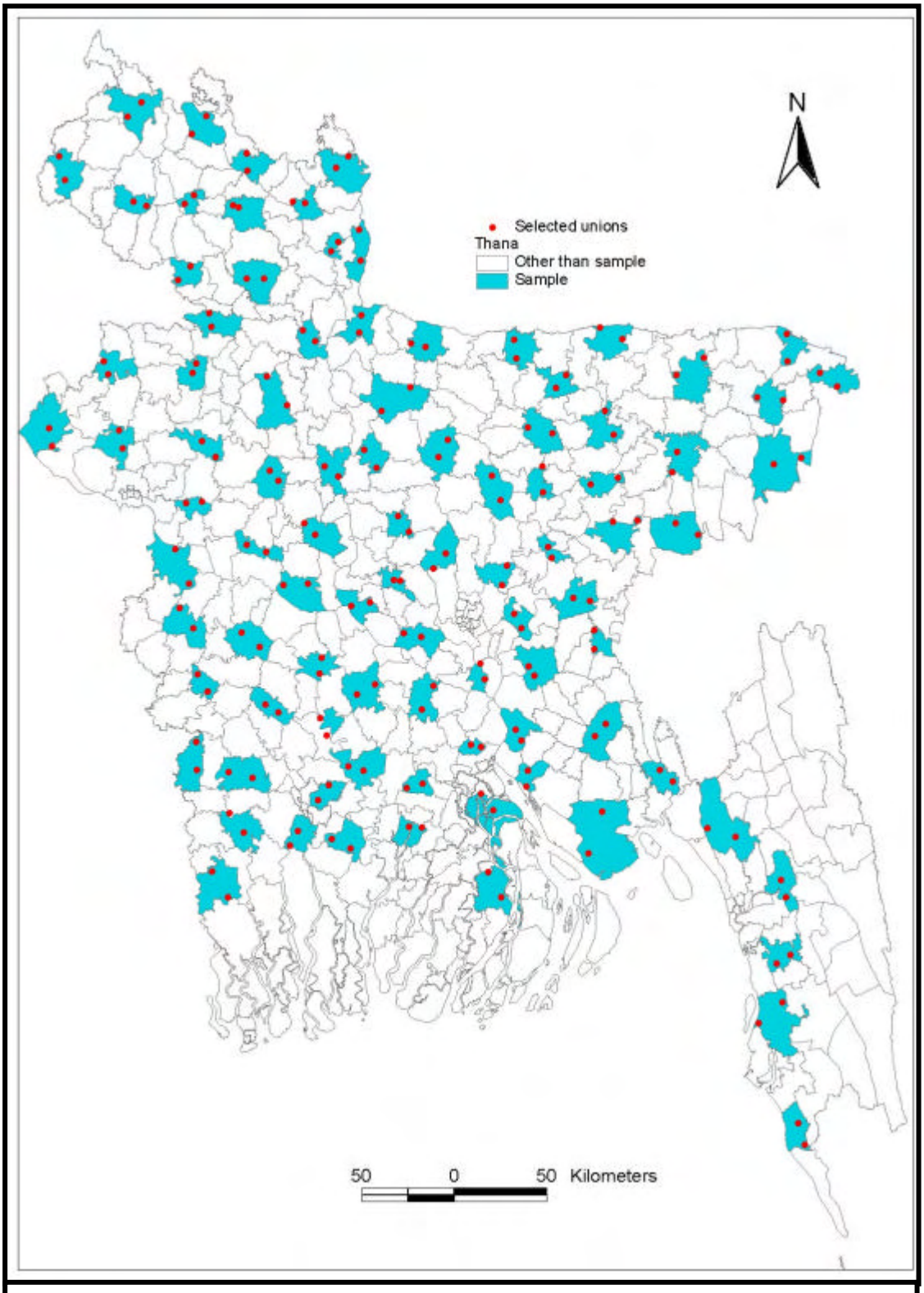


Fig. 3. Sampling thanas showing sites at union level.

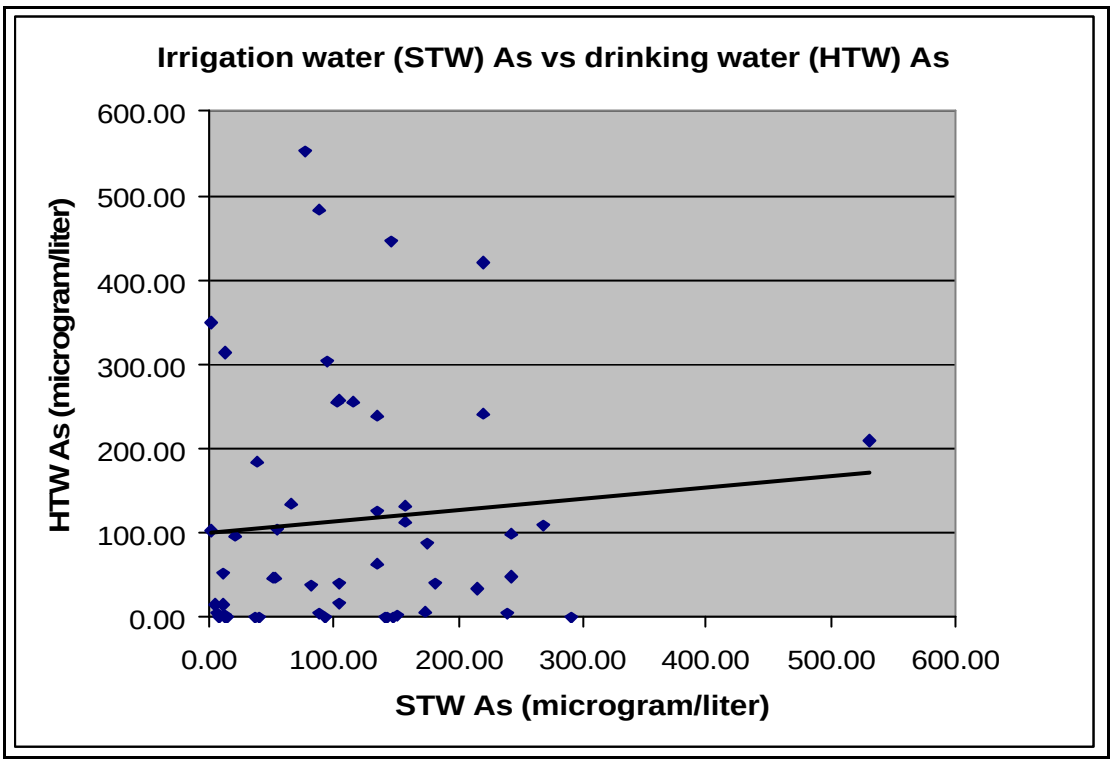
- During the Boro season of 2004, the Bangladesh partners completed sampling of STW water and surface water samples, and crop samples including rice and non-rice crops. The sample analysis is in progress. Some data on water analysis from the arsenic affected are shown below.

Arsenic content in surface water, irrigation tube well water (STW), drinking water (HTW) and surface water in some areas of southwestern Bangladesh

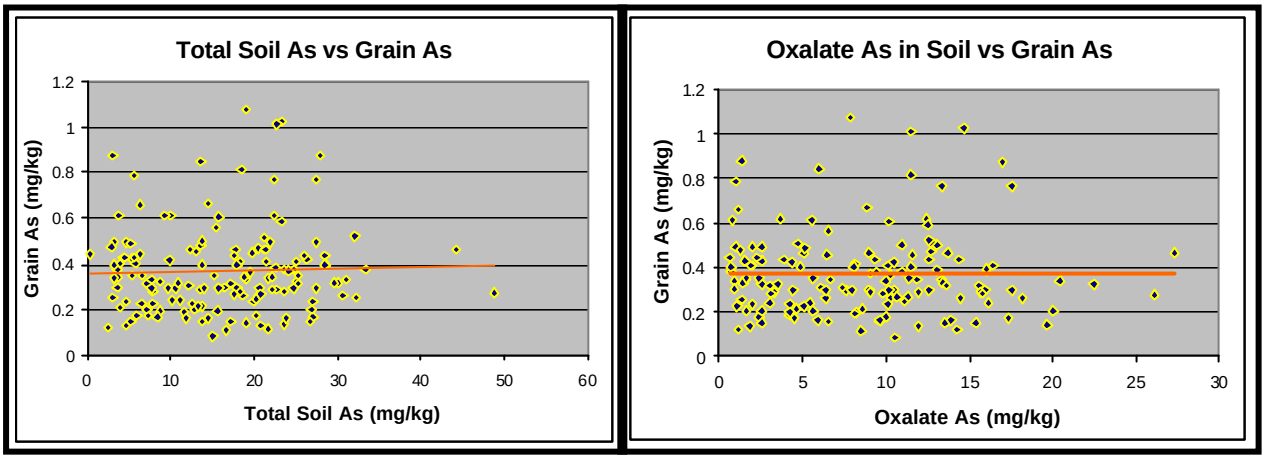
District	Arsenic (microgram/liter) STW	Arsenic (microgram/liter) HTW	Arsenic (microgram/liter) Surface water
Barisal	157.54	131.61	2.55
	115.21	255.06	3.20
	102.48	256.00	4.34
	87.59	3.94	5.19
Faridpur	54.64	105.15	1.86
	6.93	3.22	5.36
	238.51	3.83	0.93
	151.14	1.65	1.44
	103.95	16.36	3.11
	147.77	0.88	0.80
Chuadanga	88.23	482.48	7.90
	76.54	551.93	2.91
	242.98	48.75	5.77
	1.68	102.42	4.63
	13.49	312.66	1.20
	7.84	1.09	5.11
Jessore	36.95	1.02	1.68
	215.29	33.50	2.97
	13.19	1.15	1.62
	14.94	0.47	3.24
	11.89	15.48	2.83
	20.77	96.43	2.83
	11.26	51.39	7.90
	81.44	38.37	3.11
	40.59	0.74	3.98
	93.26	0.52	7.00
Jhenaidah	13.30	0.50	2.07
	53.63	45.55	2.98
	5.20	14.64	3.14
	51.91	46.87	3.26
	39.01	183.29	5.63

The arsenic content in surface waters (ponds, rivers, etc.) was found to be negligible in the arsenic problematic areas. In such areas, wherever possible, use of surface water for irrigation could be a tool to avoid arsenic contamination of the soils and crops.

Some people speculate that the application of large amounts of arsenic contaminated irrigation water could contribute to arsenic contamination of drinking water tube wells nearby. We did not find a significant relationship between the arsenic contents of irrigation water and nearby hand tube well drinking water.



- Using the data gathered so far on various fractions of arsenic in the soil as accumulated from irrigation water, we tried to determine an index of bioavailability of arsenic. However, no single parameter correlated significantly with arsenic in plant. The results point to the possibility of the intervention of factors other than chemistry and mineralogy in regulating the behavior of As in wetland rice soils, which could very well be As content of the recurrently deposited fresh alluvium, loss of As from the soil through leaching, volatilization, or any water-soil-crop management practices.



- Evidence of iron oxides partially retaining arsenic in the soil has been gathered. This is important for Bangladesh where the irrigation water contains high iron.

- A high variability of As in both time and space all the more complicates the assessment of the As hazard in the environment and the management of the problem. Geo-statistical analysis of the water, soil and rice grain As data completed for one *thana*, Tala, indicated considerable spatial variability for As.

- Spatial dependence in As content appeared to be more prominent in case of soil than either water or rice grain. However, it was not clear from the preliminary data as to whether the spatial variability of As was in soil due irrigation water As or "background As".

- A clearer understanding of the "background As" in soil will be available after the soil analysis under the national survey activity is available.

- The causes of this spatial variability and their implications for arsenic mitigation are being studied.

National Capacity Building

This has remained a major objective of the program, and is being continued in the areas of facilities and human resources development. The national partners' laboratory facilities were developed and scientists and technicians trained to handle arsenic analysis in the first year.

Facilities development

- In the second year, BARI-CIMMYT Arsenic Laboratory was established with the signing of a LOA with BARI. A new AAS for BARI and accessory equipment have been procured as the cornerstone of this laboratory. The laboratory is being further developed to an international standard where international partner scientists graduate students from USA and Bangladesh can do analytical work on arsenic.

Human resource development

- The program began sponsoring PhD degree programs at BAU for three graduate fellows and for one graduate fellow at Cornell University, USA since July 2003. These fellows are working on such topics as arsenic movement and arsenic balance in the water–soil-plant system, spatial variability of arsenic in water, soils and crops, effect of water management and phosphorus-arsenic interactions. Their research is expected to greatly improve the understanding of the arsenic problem in Bangladesh agriculture and provide a basis for the development of arsenic management strategies.

Future R&D needs

During the last two years of the program, scientists gathered information that helped greatly improve the understanding the nature and extent of the arsenic contamination problem in Bangladesh waters, soils and crops. However, there are still critical questions that need to be answered. While continuing the present activities, new research, education and technology development initiatives need to be taken. Some of these issues are pointed out below:

- Development of a nationwide database on "background arsenic" in soils and the contribution of this arsenic in addition to irrigation water arsenic to contamination of agriculture and food
- Understanding bioavailability of arsenic: Which arsenic species in water soil control the plant uptake and of arsenic? Which species are the most toxic for humans?
- What should be the safe levels of arsenic in irrigation water, soils and crops under the prevailing cropping systems of Bangladesh in terms of yield and crop quality?
- How do crops and cultivars vary in their susceptibility / resistance to arsenic? If there is significant variation, can this be used as a mitigation tool?

- A package of water-soil-crop management and cropping systems practices to avoid / manage the problem of arsenic contamination
- Fill the void in the education sector: Help develop undergraduate and graduate level courses on the behavior of arsenic in agricultural systems and options for management for Bangladeshi students
- Take an initiative on mass awareness of the problem of arsenic in agriculture and food

Agro-food Nutrition Program in Chakaria

Agro-food and education on high calcium nutrition program continued as an extension of the previous one in December 2002. The initiative was focused on prevention of rickets based on public campaigns involving live drama, video show, and demons tration of calcium rich agricultural produce through whole family training module at community level as well as production of seeds at demonstrative farm at Kumari to support seeds for the community.

Major Activites

- Live drama presentation
- Video show presentation
- Rickets Orientation Workshop with Local Development Organizations
- Collaboration with Relevant Agencies
- Demo-plots in Kumari farm and also nearby villages through Whole Family Training
- Rickets Awareness Campaigns through newspapers, posters, leaflets, desk calendars, etc.
- Exchange and monitoring visits
- Exchange-meetings with group members on Rickets

Progress

Live Drama and Video Show Presentation: Live drama in local dialect and quality video drama 'Jagoron' on rickets awareness prepared by Bengal Creative Media were organized and displayed which were found very effective in creating rickets awareness leading to consumption habit for vegetables. This drama was even telecast in a national Television channel ATN Bangla on June 6 in the evening, June 8 & 10 in the morning.

The events were successfully displayed at the community level, like hat -bazaar, public places and at staff-members level with the partner NGOs. During the period, 45 video shows and 6 live dramas after the BCM shows were demonstrated. GPS readings were recorded at the sites where dramas were organized.

Live drama on rickets awareness

Presentation of Video shows in July 2003 to June2004

Month	Location	Address	Attendance	Female %	Male %
July`03	SM chor	Kakara	300-350	30	70
Auguest`03	Fashia khali	Fashia khali	500-550	20	80
September03	Sha morabad	Kakara	600-700	30	70
	Vera Bazar	Fashia khali	500-600	5	95
	Shaira khali	Fashia khali	400-450	30	70
	North cha bagun	Malum ghat	300-350	40	60
	ICDDRB training venue with CARE partner NGOs	Chiringa	45 Representative of NGOs	40	60

Month of October`03

Date	Area	Address	Attendance	Female %	Male %
October13 '03	South shirakhali	Chakaria	400-500	50	50
October14 'o3	Hindu para	Baritholi	600-700	40	60
October15 '03	Upazila training venue with rickets workshop participants	Pakua	45	90	10
October16 '03	SARPV Campus	Chakaria	300- 400	10	90
October17 '03	Palakata school field	Chakaria	500-550	15	85
October18 'o3	Proper kakara	Kakara, chakaria	300-350	20	80
October20 '03	Mug Bazar	Chiringa	800-900	10	90
October21 '03	Rashid Ahamed high school with students	Fasiakhali	900-1000	50	50
October23 ;03	Baritholi joiner high school with students	Baritholi	400-450	40	60
October25 '03	Rasulabad	Baritholi	300-350	40	60

In November –December`03 and January to February it was not possible for display due to trouble of multimedia projector.

Video shows presentation in month of March '04

Sl#	Area	Address	Attendance	Female %	Male %
1	Gonesha bazar	Chakaria porashova	600-700	30	70
2	Hasher Digi	Fasiakhali	500-600	10	90
3	Juladas para	Fasiakali	400-500	70	30
4	Gurack gata	Mohiskhali-RIC	400-500	20	80
5	Khonia palong	Ramu	400-500	70	30

Video shows presentation in month of April`04

Date	Area	Address	Attendance	Femal e %	Male %	GPS reading
April304	Kachapia	Anando staffs,Ramu	55	50	50	--
April404	Luhagara	Uddipon & CARE staffs, Chatt.	21	20	80	N 2200.800` E 9105.00656`
April404	Luhagara Nafar tila	Uddipon Chatt.	400-500	70	30	N 2200.790` E 9105.00625
April1004	Cox`s Bazar.	Mukti staffs	22	50	50	--
April1104	Chandanish	PPS staffs	24	40	60	--
April124	Chandanish PPS	Barua para, kanson nagur	200-250	60	40	--
April1204	Bashkhali	Uddipon & CARE staffs	28	49	51	N 2205.82` E 9203.921`
April1304	Bashkhali Uddipon	Gunagori bazar	400-500	15	85	N 2204.745` E 9156.125`
April1404	Patia,Chatt	Nozowan staffs	23	40	60	N 2217.910` E 9158.356`
April1504	Patia,Chatt Nozowan	Kharna patia.	200-250	60	40	N 2217.149` E 9200.793`
May404	Kumari Bazar	Lama, Bandarban (Community)	200-250	10	90	N 21°42.870` E 092°07.391`
May504	Varamohari	Staff of CARE & ISDE-Chakaria	22	30	70	N 21°45.212` E 092°04.152`
May11/04	Jaladas para	Shayrakhali, Chakaria (Community)	400-450	30	70	N 21°42.769` E 092°04.437`
May1204	Kash para	Demoshia, Chakaria (Community)	450-500	40	60	N 21°45.326` E 091°58.515`
May1504	Teknaf Pilot high school (auditorium)	Teknaf, Cox`s Bazaar, students and staff of GK.	400-500	40	60	N 20°51.612` E 092°17.744`
May1504	Teknaf Pilot high school	Teknaf (Community/ play-ground))	350-400	10	90	N 20°51.657` E 092°17.788`
May1904	CARE Chakaria office	Mogh Bazaar,Chakaria CARE-Dinajpur team	18	40	60	N 21°45.108` E 092°04.197`

Date	Area	Address	Attendance	Femal e %	Male %	GPS reading
May2604	**Elishia bazar**	**Damoshia, Chakaria**	**250-300**	**40**	**60**	**N 21°45.128` E 091°58.782`**
May2604	**Darbes Katara**	**Demoshia, Chakaria**	**300-350**	**30**	**70**	
May3104	**Chakaria**	**Staff of Bastab**	**20**	**30**	**70**	**N 21°45.110` E 092°04.201`**

Vide show in the month of June`04

Date	Area	Address	Attendance	Female %	Male %	GPS reading
June1004	**Damushia**	**Uttar para,Chakaria**	**400-450**	**40**	**60**	**---**
June1204	**Cha Bagun**	**Dumkhali**	**300-400**	**30**	**70**	**N 21°40.780` E 092°00.166`**

Live drama show

Date	Area	Address	Attendance	Female %	Male %	GPS reading
Dec303	**CC field**	**Chiringa**	**2000-2500**	**20**	**80**	**--**
Dec1303	**Pala Kata field**	**Palakatta, Chakaria**	**2000 up.**	**30**	**70**	**--**
Dec1404	**Varamohari**	**Chiringa**	**1000-1200**	**30**	**70**	**N 21°45.265` E 092°04.355`**
Dec1504	**Bijoy monch**	**Chakaria phorasho va**	**1200-1500**	**30**	**70**	**N 21°45.784` E 092°04.305**
Dec1904	**BMI oditarium**	**Pakua**	**700-800**	**30**	**70**	**N 34°00.000` E 068°54.375`**
Dec2304	**Malum ghat high school**	**Malum ghat,Chak aria**	**900-1000**	**20**	**80**	**N 21°40.879` E 092°4.763`**

Rickets Orientation for Local Development Organizations: **SARPV arranged a meeting with CARE about rickets scenario in Cox's Bazaar. CARE management agreed to support prevention campaigns through its partners of SHABGE proje ct. There was a sharing workshop on rickets where both live and video dramas were shown several times. A sample for rickets prevalence survey involving the following nine partners were conducted in their respective project areas.**

Completion of rickets orientation with nine NGOs

SL #	NGOs	Address	Participants (Staff-members)
01	**Mukti**	**Shadar, Cox`s Bazar**	**22**
02	**Anando(2 Unit)**	**Kunia palong and Kachapia, Ramu**	**55**
03	**PPS**	**Chandanish, Chattagong**	**24**
04	**Uddipon with CARE team**	**Lohagara,Chattagong.**	**21**
05	**Uddipon with CARE team**	**Bash khali.**	**28**
06	**Nozowan**	**Patia,Chattagong**	**23**
07	**GK (Gono Shastya Kendra)**	**Teknaf, Cox's Bazaar**	**15**
08	**ISDE**	**Chakaria, Cox's Bazaar**	**22**
09	**BASTAB**	**Chakaria, Cox's Bazaar**	**20**
10	**RIC**	**Moheskhali, Cox's Bazaar**	**22**

The workshop discussed rickets issues based on current findings from CIMMYT, Cornell University, and French partners. Participating organizations are continuing campaigns on rickets prevention through calcium supplementation and promoting calcium rich vegetable production.

Collaboration with Relevant Agencies: **A 2-day workshop was held on disability laws of the government involving participants from different sectors like health, education, LGED, social welfare and from local NGOs where disability and rickets situations and were extensively discussed at Cox's Bazaar. Deputy Commissioner (DC) of Cox's Bazaar and Civil Surgeon and local Social Welfare Officials were present. The workshop prepared an action plan and included rickets issues.**

Local Ministers (Health, Social Welfare, and Communication) and Members of Parliaments (from Cox's Bazaar seats) were also briefed. Civil Surgeon talked to the BBC through SARPV with assurance of an immediate step towards prevalence study and all sectors' combined action on rickets.

Demo Plots and Whole Family Training: **Two whole family training sessions at community level at Fasiakhali and Sharakhali were held. Ten families participated with three members from each family like husband, wife and one of their daughter or son. This training program requires a major support from other projects of SARPV particularly like SHABGE. During training, the seeds were distributed to the families.**

The training contributed toward enhancing the capability of staff. Dr. Razzaque, Affiliate Scientist emphasized the quality protein maize cultivation in the communities in addition to vegetables for diversification of food consumption.

Supplement for calcium through adding lime in rice-cooking pots have been helpful as per reports of the rickets-affected families and childre n. It is being widely accepted and practiced.

Kumari Farm: C**alcium rich vegetables (Okra, Snake gourd, Taro, Yam Potato) and fruits (Mango, Guava, Olive) were raised. The seeds of Taro-600kg and Okra-6kg were produced in the farm and distributed mainly in the community.**

Campaign: **The organized disability day and agro-fair in Cox's Bazaar were truly a rickets fair with displays and information exchange in dramas on calcium rich food production techniques, calcium sources, and so on.**

A press conference on disability issues and rickets in Chittagong, Cox's Bazar and Chakaria was arranged where local representatives and journalists of the national dailies attended covering a wider coverage through the newspapers. The leaflets, posters and desk calendar only on rickets were prepared to reach different groups of audience who can collaborate on rickets prevention campaigns. The projects and programs in SARPV have been redesigned to work for advocating rickets issues at least for next five years. As a result, these are now contributing to SARPV's rickets prevention campaigns. The advocacy workshops in Chittagong, Jhenaidah, Khulna, Dhaka, Meherpur, Cox's Bazaar, Jessore, Kushtia, Chuadanga, Dinajpur, Bagerhat, Gazipur, Norsingdi, Narayanganj, Comilla, Noakhali, Feni with diverse development activities discussed about the rickets situation and its national as well as global perspectives.

Exchange Visits: **Drs. Craig A. Meisner and M A Razzaque of CIMMYT along with a USAID team, and representatives from France, UK partners and a CARE-team visited this program often. Besides, CIMMYT arranged two cross-visits for project-staff towards capacity building on agricultural technology and hill utilization process at BARI sub centers in Khagrachori and Raykhali.**

Impact

Video shows and live dramas proved to be more effective for raising community awareness compared to other techniques. Increased information about rickets cases from long distances like Teknaf, Moheshkhali, Baskhali, Patia, Chandanich, Ramu etc have been received. Regularly a lot of new rickets patients come from various places to the physiotherapy/rickets treatment center at SARPV for treatment or suggestion. All the group members started adding lime in cooking rice for consumption.

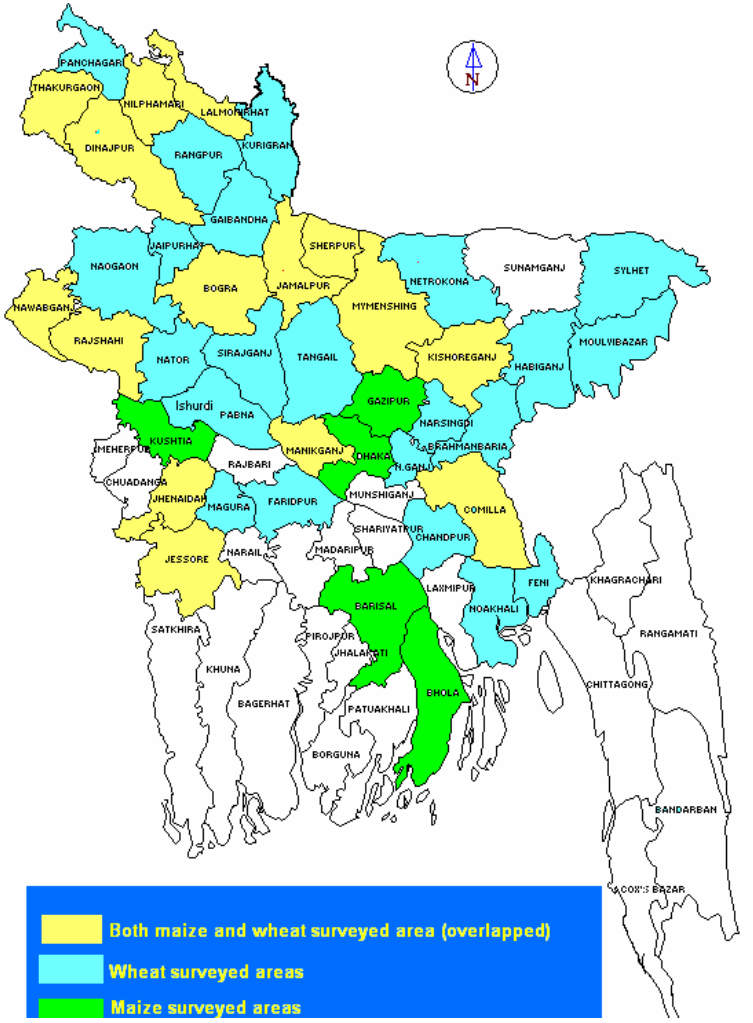
Monitoring and Evaluation of the Programs

Introduction

For the fulfillment of USAID/Bangladesh Strategic Objective No. 8, information required for its Performance Monitoring Plan (PMP) was collected. CIMMYT is responsible for the data collection on maize and wheat area and production through surveys utilizing GO and NGOs resources in its target areas.

A total of 4,702 families of been surveyed for the 42 districts, 37 for wheat CIMMYT maize and below. This was followed and 1,920 for wheat were production practices.

After maize and wheat surveyed for yield. Data sets were being entered in computer evaluation report will be September 30, 2004.



which maize (2,883) and wheat (1,819) have baseline data collection for the year 2003-04 in and 20 for maize. Surveyed locations of wheat working areas are depicted in the map by the training of 5,156 families, 3,236 for maize trained for modern maize and wheat

harvesting, the same families were again determination of actual area, production and received from the partners and simultaneously for analysis. The final monitoring and prepared and submitted to USAID on or before

Crop-wise results of maize and wheat for phase 1 survey are listed below:

A. Maize:

Out of 2,883 growers, 1,332 grew maize in the past and 2,647 would cultivate maize in 2003/04. Baseline area, production and yield were computed on the basis of 1,332 growers. However, 2,647 growers were used to compute the target area for 2003/04.

Based on the survey, the 1,332 growers reported their actual area 444 ha (0.33 ha per grower) production was 2,553 tons and yield 5.6 ton/ha for baseline year 2002-03.

For the year 2003-04, 2,647 growers reported their estimated area was 1,354 ha (0.51 ha per grower), production was 10,231 tons and yields were 7.56 tons per ha. This represented an increase in area per farmer of 54% over the last year. Similarly, the national area is also estimated to have increased to about 50%, giving credence to our sample to represent the nation. The targeted yield has been estimated to be 7.56 t/ha and production 10,231 tons for the targeted year 2003/04. Actual expansion of area needs to be verified when the actual area, production surveys are completed at the end of the season.

B. Wheat:

Out of 1,819 surveyed wheat growers, 1,744 growers grew wheat in the past and 1,744 growers would grow wheat in 2003-04 in the CIMMYT and WRC target areas. Baseline area, production and yield is computed on the basis of 1,744 growers with 1,719 growers.

Based on the survey, 1,744 growers reported their actual area was 460 ha (0.26 ha per grower), production was 1,139 tons and yields were 2.48 tons per ha for the baseline year 2002-03. For the year 2003-04, 1,719 growers reported their estimated area was 477 ha (0.28 ha per grower), production was 1,390 tons and yields were 2.91 tons per ha. This represented an increase in area per grower 8%, production 25% and yield 17%. Actual expansion of area needs to be verified when the analysis of the actual area and production surveys is completed.