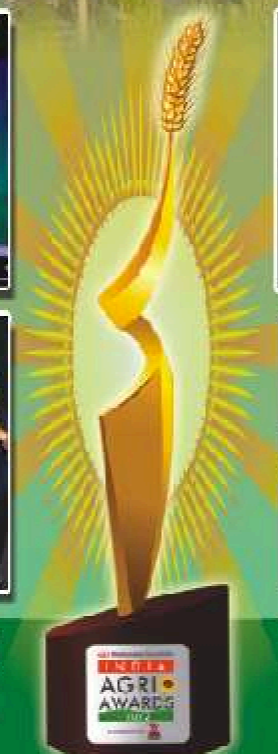


MAHINDRA KRISHI SAHYOG SAMMAN 2012

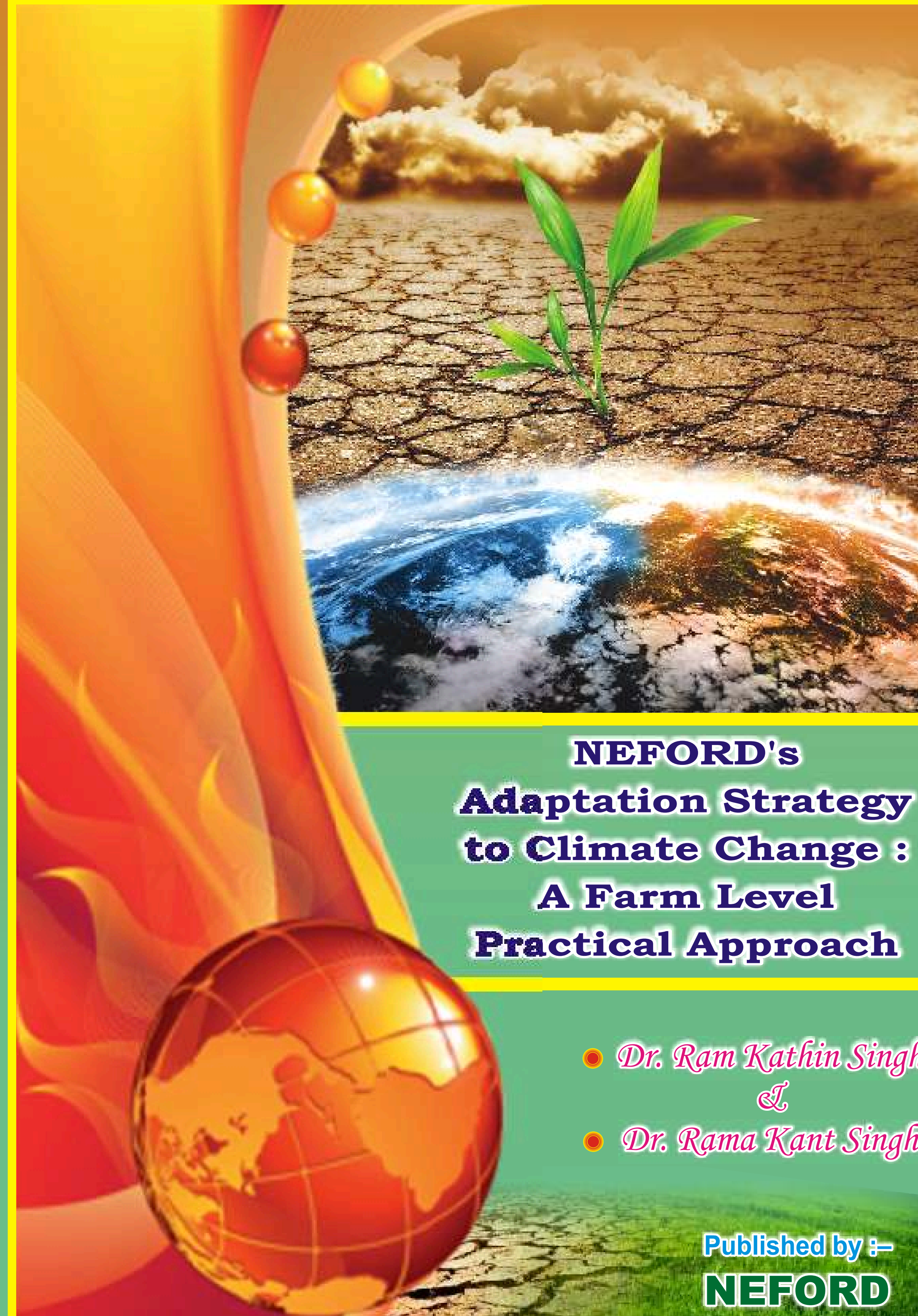
Presented by Mr. Sharad Pawar Hon'ble Minister of Agriculture & Food Processing to NEFORD.

NEFORD

Nand Educational Foundation for Rural Development

(Registered under Indian Societies Act, 1860)

A Vehicle for Empowerment of Rural Masses and Sustainable Agricultural Development



NEFORD's Adaptation Strategy to Climate Change : A Farm Level Practical Approach

- *Dr. Ram Kathin Singh*

&

- *Dr. Rama Kant Singh*

Published by :–

NEFORD

उफ ! ये मौसम का कोई सिस्टम ही नहीं रहा

जागरण विशेष

- पहले सूखा, बाद में बाढ़, घट गया जाड़े का माह
- बदले वातावरण में बढ़ गई गर्मी व बरसात की मियाद

जलवायु परिवर्तन के कारणों का पता लगायेगा नेफोर्ड

मौसम की पैंतरेबाजी से बदला फसलों का रंग

तो क्या बदल जायेगा मौसम चक्र...

सूखा से न हों परेशान, छोड़िये जोताई, सीधे बोइये धान

- वरिष्ठ कृषि वैज्ञानिक डा.रामकठिन सिंह की किसानों को सलाह

अभी तक हो सकी है मात्र 37 प्रतिशत रोपाई

विश्वास न हो तो आइये कहिनौर....

जिले जहां सामान्य से एक चौथाई भी नहीं वर्षा हुई			
जिला	औसत वर्षा होनी चाहिए	वर्षा हुई	औसत वर्षा का प्रतिशत
गौतमबुद्ध नगर	200 मि.मी.	17.3 मि. मी.	8.7 मि.मी.
गाजियाबाद	200 ,,	17.3 ,,	8.7 ,,
अम्बेडकर नगर	304 ,,	31 ,,	10.2 ,,
पीलीभीत	397 ,,	40.8 ,,	10.3 ,,
हाथरस	187.4 ,,	23.2 ,,	12.4 ,,
रामपुर	279.3 ,,	40.3 ,,	14.4 ,,
कुशीनगर	357.9 ,,	55 ,,	15.4 ,,
मऊ	300 ,,	46.1 ,,	15.4 ,,
एटा	188.6 ,,	30.4 ,,	16.1 ,,
बलरामपुर	357.9 ,,	58 ,,	16.2 ,,
देवरिया	357.9 ,,	73.5 ,,	20.5 ,,
उन्नाव	236.9 ,,	51.5 ,,	21.7 ,,
ज्योतिबाफुले नगर	279.3 ,,	62.5 ,,	22.4 ,,
बलिया	290.8 ,,	65.9 ,,	22.7 ,,
बिजनौर	325 ,,	77.8 ,,	23.9 ,,
मैनपुरी	188.4 ,,	45.2 ,,	24 ,,
अलीगढ़	187.4 ,,	45.8 ,,	24.4 ,,

बीते पांच वर्षों में जुलाई माह में हुई बारिश		
वर्ष	कुल बरसात (मिमी. में)	औसत से विचलन
2004	147.3	47 फीसदी कम
2005	263.0	पांच फीसदी कम
2006	342.0	24 फीसदी ज्यादा
2007	246.7	4 फीसदी कम
2008	444.3	61 फीसदी ज्यादा
2009 (अब तक)	59.0	80 फीसदी कम

Nand Kharif Kisaan Mela, 2011

Dr. J. Prasad, Chairman, Higher Education Commission visiting Stalls

Nand Kharif Kisaan Mela, 2012

Dr. R.P. Singh and Dr. N.K. Singh receiving Krishak Mitra Samman at Kisaan Mela

NEFORD's Adaptation Strategy to Climate Change : A Farm Level Practical Approach

—: Work Done Under :—

National Initiative on Climate Resilient Agriculture (NICRA)

—: Sanctioned by :—

Central Research Institute for Dryland Agriculture (ICAR), Hyderabad

NEFORD

Nand Educational Foundation for Rural Development
Head Office: 1, Devlok Colony, Church Road, Vishnupuri, Aliganj, Lucknow, Uttar Pradesh (India)
Mobile: 09721719736 Phone: 91-522-4015742 Fax: 0522-2323226, 0522-4015742
Website: www.neford.org Email: rksingh@neford.org
Delhi Office: A-25, Second Floor, Vikalp Apartments, 92, I.P. Extension, Patparganj, New Delhi92 (India)
Phone: 91-11-22243425 Mobile: 91-9811318445

Dr. B. Venkateswarlu, FNAAS
Director, Central Research Institute for Dryland Agriculture (ICAR),
Santoshnagar, Saidabad PO
Hyderabad 500 059, AP, INDIA
Ph :+91-40-24530177; Mobile : 9652988265
Fax : +91-40-24531802
Alternate Email : director@crida.in

Foreword

Active participation of farmers is critical in assessment of field level adaptation strategies to climate variability. Though, there are many best-bet practices which can help farmers to cope with climate variability, farmers are not aware of these practices and their adoption. Hence, there is an urgent need to demonstrate the climate resilient agricultural practices in the vulnerable districts, so that the performance of the technologies can be scientifically assessed and feed-back on adoption constraints are documented. In this context, several attempts are being made to demonstrate climate resilient agricultural practices in most of the vulnerable districts of the country through Krishi Vigyan Kendras, Agricultural Research Centres and Non-Governmental organizations.

In this context, Nand Educational Foundation for Rural Development (NEFORD), Lucknow has taken up the participatory technology demonstration project under NICRA covering the flood prone districts of Eastern UP. The organization has successfully demonstrated several sub-mergence tolerant varieties of paddy and quantified the impact of such technologies on yield and farmers' income. NEFORD has also studied the advantages of sanda method over transplanted rice in flood prone regions. Based on the two years demonstrations, farmers in the districts have immensely benefited and the organization is planning to upscale the technologies in 18 more villages during the current year. The unique participatory approach adopted by NEFORD has resulted in successful implementation of the project.

I complement the scientists of NEFORD and the farmers in the target villages for their collaborative effort in tackling one of the most important problems like climate change and bringing out this publication which I am sure will be useful to farmers and extension staff working in the region.

Dr. B. VENKATESWARLU
Director, CRIDA

Nand Rabi Kisaan Mela, 2011

Dr. S.K. Datta, DDG (Crops) in Kisaan Mela

Dr. N.P. Singh being honored by Dr. S.K. Dutta

A view of meeting hall at Kisaan Mela

Nand Rabi Kisaan Mela, 2012

Dr. Rajendra Prasad PD, DSR, Mau

IRRI Scientist honoring a farmer at Kisaan Mela

Seed Distribution and Orientation Training

A view of farmers' group discussion on Climate Change in Different Villages

Abstract

The agriculture in eastern U.P. is largely rainfed and characterized by dominance of small and marginal resource-poor farmers who often face the problems of flood, drought and salinity, resulting in low and unstable yields. As per the Inter-governmental Panel on Climate Change (IPCC), the impacts of climate change could be significant for the poor people living in the marginal areas, like that of eastern U.P. Keeping this in view, the present project was sanctioned under the competitive grants of NICRA with the main objectives of understanding the long-term pattern of weather parameters and farmers' perception of climate change and accordingly, to identify and promote technological options adapted to these changes and minimize farmers' losses. The project, therefore, firstly reviewed the long-term (1901-2007) weather data in the project districts and conducted Focus Group Discussions with the farmers and short-listed major problems that needed solution. Beside labor shortage, early drought, flood, salinity and early rise in temperature at the time of grain filling, were found to the main limiting factors. In view of these, large scale participatory technology testing and demonstrations were conducted covering the flood-prone, drought-prone and salt-affected areas in districts Mau, Ghazipur and Azamgarh. Various options were tried and suitable technologies were identified and the impact of such technologies on yields and farmers' income were quantified. Selection of rice and wheat varieties tolerant to various stresses, as identified above, and the safe and productive stress-specific cropping systems have been the major outcomes of this project. Similarly, while direct seeding of rice and zero-till sowing of wheat were promoted as labor-water saving crop establishment methods, an age-old practice of sanda (double transplanting) method of rice cultivation was improved and promoted to overcome the problems, especially arising due to delayed monsoon. Although the method required more number of labor for double transplanting, the increased cost was duly compensated by the fact that it required less quantity of seed, less number of life-saving irrigations, no cost of weed-management and gave higher yields. The average net return in case of sanda method was Rs. 29,000/- per hectare, compared to Rs. 12,000/- per ha for normal transplanting. Significantly, the project also evolved an innovative '5-step transfer of technology model' that ensured accelerated pace of technology transfer by reaching out large number of people-stakeholders, in shortest possible time. During the last two years of project period, NEFORD could sensitize more than 23 thousand farmers in eastern U.P.

Citation :

Singh, R.K. & R.K. Singh. 2013. NEFORD'S Adaptation Strategy to Climate Change : A Farm Level Practical Approach. Nand Educational Foundation for Rural Development (NEFORD), 1, Devlok Colony, Church Road, Vishnupuri, Aliganj, Lucknow-226022 (U.P.), INDIA, 24 pp.

Institutional Publication 2013/1

Published by :

Ram Kathin Singh
Director, NEFORD

1, Devlok Colony,
Church Road, Vishnupuri, Aliganj,
Lucknow-226022 (U.P.), INDIA
Mobile : 09721719736

Acknowledgment :

We thankfully acknowledge the generous support of NICRA staff, especially Dr. B. Venkateswarlu and Dr. M. Maheshwari, and the ICAR for giving us the opportunity to participate in the National Initiative on Climate Resilient Agriculture, and to contribute to farmer's welfare.

Dr. Ram Kathin Singh
Director, NEFORD

Dr. Rama Kant Singh
Principal Investigator

Training on Weed Management and Distribution of Weedicide Packets

Field Days

Field Gosthi in Village - Gohta, District - Mau IRRI Scientist Dr. D. Mckill speaking to farmers.

NEFORD's Adaptation Strategy to Climate Change : A Farm Level Practical Approach

Introduction

World-wide efforts are being made and strategies developed for mitigation and adaptation to climate change. But what is really more important is the action at the farm level, because it is the farmers who face the impact of climate change in their daily life. Sudden rise or fall in temperature, excessive rains causing floods or scanty rains leading to water stress and droughts, changing pests complexions, soil-health problems and salinity are some important factors causing concern and need immediate attention. Inter-Governmental Panel on Climate Change (IPCC) considered India to be 'acutely vulnerable to the impacts of the climate change'. However, a report on impacts of climate change on Indian agriculture maintained that these impacts would be region-specific, and could be significant for poor people living in marginal areas. The eastern UP, characterized by dominance of small, marginal resource-poor farmers often facing the problems of flood, drought, salinity/sodicity, is likely to have large impacts of such climate changes. Keeping these in view and also the fact that there already exists some robust technological options that could help reduce farmers' losses, the present project was proposed and was sanctioned under competitive grants of NICRA, with following three broad objectives:

1- Analyzing changes in weather parameters and farmer's perception of climate change, impacts and coping mechanisms.
2- Matching and promoting technological options to adapt to climate change to minimize farmers' losses.
3- Capacity building and reaching out large number of farmers in shortest possible time to make them aware and prepare for the days ahead.

Methodology

To properly understand the pattern of climate change, long term (1901-2007) secondary data on rainfall distribution pattern, temperature, occurrence of floods and droughts in the three project districts- Azamgarh, Mau, Ghazipur, were studied, and the pattern of climate variability thus obtained was further confirmed by an output from a 'Focus Group Discussion', conducted in these districts, with farmers. This study helped us shortlisting major agro-climatic and socio-economic problems and, accordingly, matching and promotion of technological interventions, were planned.

Salient Findings

Weather Data Analysis & Farmers' Perception

The long term (1901-2007) rainfall data analysis of eastern UP districts clearly showed that after 1980's, the annual as well as seasonal rainfall has remained bellow the normal. Decline in rainfall, particularly, in early months of monsoon i.e., June, July, August, September has become more frequent after 1980's, making early drought a regular feature, resulting in either delayed nursery raising, slow and stunted seedling growth and/or transplanting of aged seedlings. The farmers, having no proper irrigation facilities, often abandon and burn the nursery in the field itself. During kharif 2012 for example, only about 34% farmers transplanted rice with less than 30-day old seedlings, while 50% farmers used older seedlings and the remaining 16% could not transplant and discarded the nursery.

The findings of the 'Focus Group Discussions' with the farmers further confirmed the weather data analysis findings. Besides labor shortage, flood, drought, salinity and early rise in temperature during summer, were identified as the major limiting factors.

Technological Options

In view of the problems identified as above, NEFORD zeroed in on following options : (i) stress tolerant crop varieties; (ii). cropping systems for stress-specific ecologies; (iii). water-labor saving crop establishment methods; (iv). organizing seed-producer farmers's groups and knowledge dissemination; and finally, (v). develop an innovative transfer of technology model for fast spread of mature technologies.

(a) Selection of stress tolerant crop varieties : A large number of candidate genotypes were tested and screened for resilience to different stresses using 'Mother' and 'Baby trials' and the promising varieties/genotypes were identified through 'Participatory Varietal Selection' (PVS) approach and are being promoted among farmers, as the adaptation strategy to reduce vulnerability (Table1).

A crop of Swarna Sub1 recovered after 10 days of submergence

An IRRI team inspecting performance of Swarna Sub1 on farmer's field

Field performance of the salt-tolerant rice variety CSR-36 on farmer's field

Comparative performance of CSR-36 vs Moti in Sanda Method of Rice Cultivation

The performance of some of these varieties as obtained on farmers' fields during 2012-13 are given here.

Table 1 : List of selected stress-tolerant crop varieties

Crop Varieties	Main Feature	Remarks
Rice Varieties		
Swarna Sub1 IR 64 Sub1	Submergence tolerant	Jointly released by NEFORD and NDUAT
CSR 36 K 3119	Salt-tolerant	CSSRI varieties Jointly released by NEFORD and GBPUAT
Sushk Samrat Sahbhagi Dhan	Drought-tolerant	NDUAT variety Variety of Central Rainfed Upland Rice Research Station (CRRI), Hazaribagh
Wheat Varieties		
KRL 213 KRL 210	Mild salt tolerant	CSSRI, Karnal
KRL 19	High salinity tolerant	CSSRI, Karnal
NDW 1014 Halna WR 544 PBW 154	Short duration heat tolerant	NDUAT, Faizabad CSAUAT, Kanpur IARI, New Delhi PAU, Ludhiana

Swarna Sub1 : Although 2012-13 was a drought year, several rain fed areas in eastern UP got submerged for varying durations. The data collected from 185 farmers' fields of these areas on performance of the submergence tolerant rice variety, Swarna Sub1, showed that with the increasing duration of submergence, the reduction in yield of Swarna Sub1 was much less, compared to the adjacent variety planted by the farmers (Fig. 1). Even after a submergence of about 10 days, Swarna Sub1 gave an yield of 3.2 t/ha, while the yield of the control variety was only 1.7 t/ha. On the whole, Swarna Sub1 produced about 1 t/ha more yield than the control variety.

Also, in trials during previous years, Swarna Sub1 has shown similar advantage over the checks. Thus, U.P. having about 7-8 lac hectare of submergence-prone area, if Swarna Sub1 is promoted, it can easily produce 7-10 lac tonnes of additional rice in U.P . and also help flood-affected farmers to raise their income.

Shushk Samrat : The performance of a drought tolerant rice variety, Sushk Samrat, was compared with two prominent local varieties, Moti and Sarju-52, under three levels of irrigation on farmers' fields. While with three irrigations, all the three varieties yielded at par, with two and, particularly with one irrigation, Shushk Samrat out yielded both the checks. With one irrigation, the average yield of Shushk

Fig. 1 : Performance of Swarna Sub1 under flooded conditions of eastern UP : Kharif 2012

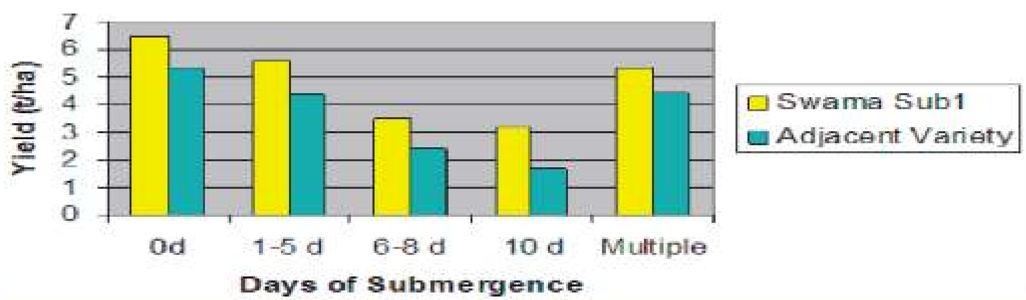
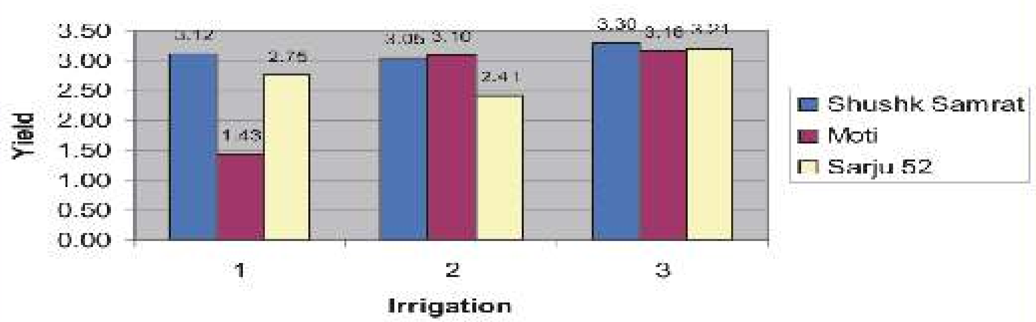


Fig. 2 : Effect of irrigation on rice productivity under drought conditions



Samrat was 3.12 t/ha, compared to only 1.43 t/ha of Moti and 2.75 t/ha of Sarju 52 (Fig. 2). In addition, to compare the performance of Shushk Samrat with Moti, as the check under an NFSM program, a cluster demonstration of about 125 ha on farmers' fields was also conducted. Shushk Samrat gave an average yield of 4.29 t/ha, as against 3.4 t/ha of Moti. Shushk Samrat, therefore, seems to be an excellent adaptation option for improving productivity of the 6-7 lac hectare drought-prone rice areas in U.P.

CSR-36 : A salt-tolerant rice variety, CSR-36 was the third variety identified by NEFORD. This variety was also tested under NFSM cluster demonstration program, covering an area of about 132 ha in district Azamgarh, Mau and Ghazipur. CSR-36 gave, on an average, a yield of 3.36 t/ha, compared to 2.45 t/ha yield of Sarju 52, the check variety. Segregating the CSR-36 performance according to the level of salinity, showed that it gave 1.85 t/ha yield under the severe salinity

Performance of a drought-tolerant rice variety Shushk Samraton farmers' fields (District - Mau)

Comparative performance of Shushk Samrat vs Moti on farmers' fields.

Participatory Varietal Selection in a Wheat Mother Trial in Village Baharipur, District - Mau

condition, as against only 0.8 t/ha of Sarju-52; the yields were much higher, ranging between 3.3t/ha and 4.4t/ha, under medium to mild salinity conditions. (Table 2). Thus, CSR-36 provides an excellent option to improve and stabilize rice productivity of about 6 lac hectare salt-affected areas of U.P.

Table 2 : Performance of CSR 36 under different levels of salinity

Level of Salinity	No. of farmers	Avg. yield (t/ha)	Productivity Range (t/ha)
Severe	18	1.85	<2.5
Medium	52	3.35	2.5 -4
Low	25	4.45	>4
	Total	95*	
	Overall Average	3.36	

* Five farmers crop have failed out of 100.

Stress-tolerant in Wheat : The field screening of wheat varieties has lead us to identify four heat tolerant short duration wheat varieties namely, Halna, NDW 1014, PBW 154 and WR 544 (Table 3). Similarly, for the high sodic soils, KRL19 and for mild sodic soils, KRL 210 and KRL 213 were found to be highly productive and stable. Large scale promotion of these varieties are being undertaken (Table 4).

Table 3 : Performance of late sown (16-01-2012) wheat varieties in farmers field (20 farmers)

Varieties	Average yield (t ha-1)	HI
HD 2985	0.94	42
WR 544	2.06	39.5
PBW 373	0.88	27
Halna	2.66	48
HD 2733	1.23	46
PBW 154	2.12	41
HD 2643	1.10	45
PBW 502	1.64	32

Table 4 : Screening of wheat varieties under low and high salinity levels

Salinity Level	Varieties	Yield Range (t/ha)	Mean Yield (t/ha)	HI
Mild Salinity	HD 2643	2.39-3.09	2.74	36.1
	HD 1563	2.25-2.91	2.58	34.4
	KRL 213	2.96-3.49	3.23	47.8
	KRL 210	3.92-4.28	3.94	46.3
	UP 2338	2.12-2.69	2.40	38.7
High Salinity	HD 2733	0.74-0.94	0.84	15
	NDW 1014	1.14-1.74	1.57	25
	KRL 19	1.69-2.09	1.89	35

(b) Cropping Systems: Based on two years of field testing, NEFORD has identified safe, productive and profitable cropping systems, suited to three major stresses, faced by farmers in eastern UP (Table 5). While a comparative performance of these cropping systems is being studied, analysis of 'Swarna Sub1' rice - Halna wheat' combination for flood-prone area has been completed. (Table 6). As the data. indicates Swarna Sub1 rice - Halna wheat combination gave a higher net return (Rs. 47,001 per ha) and B/C ratio (2.40) than the combination of Swarna Sub1 with the long duration high yielding wheat variety, HD2285. This is simply because Halna being a short duration (100-day duration) variety, could complete its life-cycle and produce 3.86 t/ha yield even when sown in the first fortnight of January, while HD 2285, a long duration variety, suffered due to hot wind at the time of grain filling and produced much less (1.9t/ha) than its normal potential.

Table 5 : Selected Cropping Systems for Different Stresses

Salt affected area	:	CSR-36(rice) – KRL 19 (wheat)
Flood affected area	:	Swarna Sub1 (rice) - Halna (wheat)
Drought-prone area	:	Sahbhagi dhan/Sushka Samrat (Rice) - NDW 1014 (wheat)

Table 6 : Cost Benefit Ratio of Rice-Wheat Cropping Systems*

Items	Cropping Systems			
	Combination 1		Combination 2	
	Swarna Sub1	Halna	Swarna Sub1	HD2285
Yield (q/ha)	42.34	38.55	42.34	19.28
Cost (Rs/ha)	17,500	16,000	17,500	16,800
Total Cost (R + W) (Rs/ha)	33,500		34,300	
Gross Return (Rs/ha)	38,106	42,405	38,106	21,208
Total Gross Return (R+W) (Rs/ha)	80,511		59,314	
Net Return (Rs/ha)	**47,001**		**25,014**	
B / C Ratio	2.40		1.72	

*Swarna Sub1–Halna; Swarna Sub1–HD 2285

Note : Data collected from 20 farmers' fields

(c) Crop Establishment Methods: Besides promoting direct seeding in rice and zero till sowing of wheat, NEFORD upgraded and promoted an age-old practice of double transplanting in rice, called 'Sanda Method'. The technique seems to provide an excellent solution to the problems arising due to delayed monsoon.

Performance of a short-duration early maturing NDW-1014 vs long-duration HYV-HD2733 in farmers fields

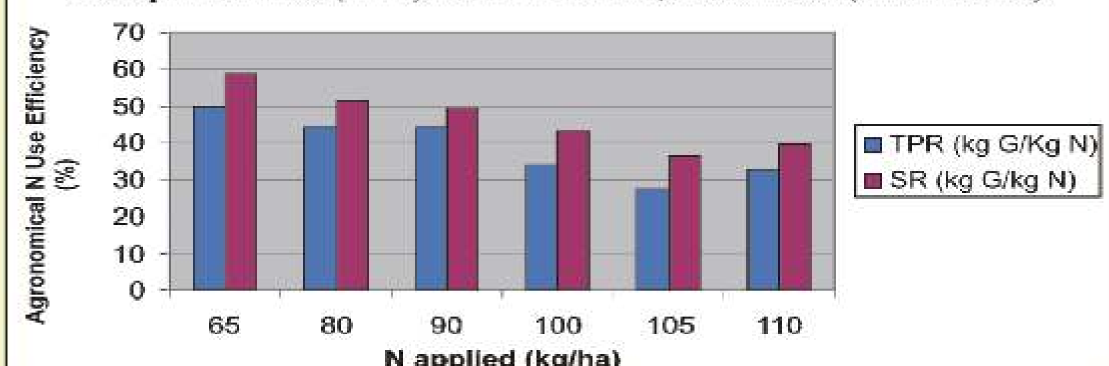
Performance of a zero-till sown wheat variety HI-1563

Performance of KRL 19 vs PBW 343 in Saline/alkaline condition in Village - Karanpur, Block - Palhani, Dist- Azamgarh during Rabi 2012-13

Methodology : For Sanda method, the seed bed preparation for nursery raising is done in the same way as for the normally transplanted rice. Well cleaned 4 kg of seed is sown in 40m^2 nursery area, which is sufficient for transplanting 1 ha of area. The seedlings, aged 21-25 days, are uprooted and transplanted @8-10 seedlings per hill in close spacings, covering an area of 400m^2. This first close transplanted rice in small area, is maintained by irrigating the field when stressed during early stage drought. After 30-35 days, the first transplanted rice is uprooted, roots are cleaned in water and seedlings and tillers are separated. The separated seedlings are re-transplanted using the spacings recommended for transplanted rice @ one seedling per hill in one hectare area. This second time transplanted rice is cared for as the normal transplanted rice.

Field demonstrations and farmers' experience: In May 2012, a group of 50 farmers were trained in Sanda Method of rice cultivation, especially giving them the tips on 'do's & don'ts'. Of these, 34 farmers, each having a piece of land of about one acre, were selected to conduct demonstrations and given seeds of Moti variety, free of cost. They were instructed to plant half of their field using sanda method and other half using normal transplanting. Farmers used fertilizers as per their paying capacity, but only nitrogen was considered in this observation. A comparison of two methods of rice establishment showed clear superiority of Sanda method to normal transplanting, both in respect of grain yield and agronomical N use efficiency. The increase in grain yield due to Sanda method ranged between 0.41 and 0.94 t/ha with a mean of 0.73 t/ha. The agronomical N use efficiency in sanda method was higher than that of the transplanted rice, irrespective of level of N applied (Fig 3).

Fig. 3 : Comparison of rice productivity and agronomical N use efficiency in Sanda method (SR) of rice establishment over transplanted rice (TPR) in Mau district; 34 farmers (Kharif 2012)



The cost of cultivation analysis also revealed that rice established using Sanda method was more profitable than the transplanted rice; the net return in case of former being Rs; 28,800/- compared to only Rs. 11,900/- in case of the latter (Table 7).

Table 7 : Cost and return analysis of rice cultivation under Sanda and Normal method of transplanting

S. No.	Items	Sanda Method	N. Transplanting
(A) 1	Cost of seed*	120.00	1,200.00
2	Seedling raising	205.00	820.00
(B)	1st close transplanting	1,382.50	0
(C)	Main rice crop (1 ha)	17,520.00	24,420.00
(D)	Post harvest	12,218.00	12,218.00
	Total Cost of Cultivation	**31,445.50**	**38,658.00**
(F)	Grain yield and return		
1	Yield (t/ha)	4.71	3.95
2	Gross return (Rs/ha)**	60,288.00	50,560.00
3	**Net return (Rs/ha)**	**28,842.50**	**11,902.00**

* at the rate of Rs. 30 per kg

** Govt. procurement rate of Rs. 1280 per quintal rice was used for calculation.

Advantages and disadvantages: The *Sanda* method of rice establishment has more advantages than disadvantages. It requires only 4 kg seeds to transplant one ha area, while 40 kg seeds are required for normal transplanting, thus there is a saving about Rs. 1,000 per ha. Further, it escapes early stage drought during seedling and vegetative growth period (50-55 days), because it is easy to maintain closely transplanted rice in a small area with limited amount of irrigation water, which saves ground water, diesel for operating pump and manpower to look after. Also, it requires only a few (1-2) life saving irrigations, if drought occurs during vegetative to reproductive to maturity stages, while the transplanted rice needs 3 to 5 irrigations, which again enhances the cost in normal transplanting. It has been observed that the rice transplanted using sanda method bears more number of tillers per hill and all tillers bear panicles and panicles are heavy, the grains fully filled than in transplanted rice.

However, sanda method has two distinct disadvantages also; firstly, it requires more number of labour for two transplanting, uprooting, cleaning and separating of seedlings; secondly, it is suitable only for long duration rice variety like Moti, Swarna, Kalanamak, etc. However, it must be noticed that the increased cost of labour for two transplanting is duly compensated by the fact that sanda method requires less quantity of seeds, less number of life saving irrigations, no weed management cost and gives higher yields.

Summary

- Early drought has become a common occurrence in eastern UP that causes delay in nursery raising as well as transplanting.
- Out migration has increased and there is increased inclination of rural people towards non-farm activities.
- Stress tolerant rice varieties for submergence, drought and salt affected areas and wheat varieties tolerant to salinity and heat, were identified to cope with these problems. Similarly, safe & productive cropping systems specific to these stresses were also developed and promoted.
- Sanda (double transplanting) method of rice cultivation provides an excellent solution to problems arising due to delayed monsoon.
- Farmers generally used higher doses of N while better yield and higher NUE could be obtained with lesser N combined with balance doses of P, K & Zinc.
- Seed-producer farmers' groups were organized, trained and initiated in seed production, especially of stress-tolerant crop varieties.
- An 'Innovative Transfer of Technology Model' was developed that hastens process of technology adoption by reaching-out people in shortest possible time.

❐❐❐

? **Ensuring local availability of seeds:** Availability of seed is a pre-condition for spreading a seed-based technology. Generally, the formal system of seed-chain takes a few years before the seed reaches farmers. NEFORD, therefore, promotes farm level seed production by training farmers' groups who, in turn, meet the immediate farmers' seed demand, locally. During 2012-13, the farmers produced 1080q of seed of three stress tolerant rice varieties and 2700q of four wheat varieties which they shared with fellow farmers. We also encourage and monitor farmers to farmers' seed diffusion. A survey of 576 households in 36 different villages of 6 districts of eastern UP, it was found that the adoption rate of Swarna Sub1 among neighborhood was about 35% (NEFORD STRASA Report 2012). Our approach also creates demand and puts pressure on the public and private sector players to hasten the process of formal system of seed production.

? **Reaching out:** NEFORD has evolved and tested a number of novel approaches to quickly reach out people and disseminate knowledge. This, in turn, creates demand for the technology (i.e. seed) and forces Government to change/frame policies to favor speedy dissemination. Our approach includes: organizing seeing is believing trips, walk through farmer's field, theme-based Kissan Mela, District agricultural Development Forums, success stories and use of print and electronic media. During the last two years of project period, NEFORD sensitized more than 23,000 farmers in eastern UP.

? **Influencing policies:** Release of Swarna Sub1, based on only one year (2009-a flood year) large scale field data generated by NEFORD and on-station data by NDUAT Faizabad, was a land mark decision of the State and the Central Govt. to fast spread this variety among the flood affected farmers. Similarly, the decision of Ministry of Agriculture (MoA), Govt. of India to support 10,000 ha cluster demonstrations of stress tolerant rice varieties during 2012-13 under NFSM program provided strong boost to promote adoption of these varieties; NEFORD was the key partner in this program in U.P.

ßGS_w´ñßÁ‰<þ€Œ?

ßeÆÂ#ƒ›³ÀØ¤Ë×ï,i¦ãïü \÷dpÑÞy…æ#¤rŠë÷X„Á"ƒÀÌØ"Ð1>V“Ÿ¾êK¸Ä%þlžDÆyû ßbÃ=IU'Ï0Ý>žµP\tá Ãwƒn†'ÿ_ÀØåñ!^ßKWo.›¹Å&‡Ä‰êöWc{ˆÂc¯¼È)Ä_kÌ-9ŸYºÆ ßVn¢ßkŸò/œ S_À!Ûä_Ú#W¸Åcåøe™±¾Ê+ÆaníÌ;¤u V#ŖÚç|Ý>V%1Iäðuª¶|xµòþ_ ß2“!9 «ÃÏ..éJb£%Ť™'ˆ”¬¸ö3 Ïý• »Óß÷4q®ëžDŶË XdÅ&c–÷ŸÜ=Ð®ºÒnz'ÿ.ñ7tÕ6…'þ ßV“Ÿamî,çHÔáBÝ>JßÑý—¤f£àìø5rÓ¢é´@¡-Å&cÂ_À-9š¦wØþ±3 èôáNZ—¤Ÿ¥ðQÿ`ÁT'òþ ß1ÌØð]ŒƒðQ4”¡Þ–Ô5ðq[Ýñý ¥²sÔr•ì ÿ`ÁC ¥O\½ÉÕ6—ødÇ·®htŒÊD'®ª¹ êKW”õ ßVbŸÜžû8u¸šÚæ#,‹—ÔŸ-Š¢¯ÇA~»µÇÓëàø5A~ŠKž

ß–Ó4j@ž¦AMeß¨ˆÌØq~»ÇÓ} ×ïh 2>KWûç6–Å&>žÿŠ,ŽÐnÏ<Hŧÿ`ÁèôU¶ó0¢ËLXpÑoÐ ßV·#/• q%@Â×8uŒÇIaÂ#RÊâC¤.'qT̨zÛó" ¹lx IªçHTN¯Ç(%@Ñ2fÊ7CþÿxÙ» É|"õVšú ßVwš=U¶bTYqÒ-o A~ß@Ÿ!,ã½‹—ØWoÐ†laKcÄ%ö ¢ß@SM̱ Õ6N¯q̧áB€ËnA®øz'óTµ© ß¨À •ÿ_²}¬ $×u¾ûD¸õVÌbjv³• sÔZ»Ç( Ü=ÿ<©"¥½Éá}%ß8D\le'òÿ` "ƒä S_¹µ":wäE¦ ßwƒð • ,8¥µ"ƒ #`ÅkwØ!?

Table 8 : Yield advantages due to higher and recommended doses of N application alone & with P and Zn in farmers fields (Kharif 2012).

Fertilizer Dose	Rice grain yield (t/ha)					Mean yield (t/ha)	% advantages	NUE	Contribution of P and Zn (%) to yield	
	F1	F2	F3	F4	F5				P	Zn
N60	1.87	2.12	1.98	2.04	1.71	1.94	0	32.40	0	0
N80	3.00	2.48	2.88	3.10	2.67	2.83	45.88	47.10	0	0
N80 : P15	3.72	3.90	4.35	3.65	3.16	3.76	93.81	62.60	32.86	0
N80 : P15 : Zn5	4.40	4.40	4.20	4.50	3.70	4.24	118.56	70.67	0	12.77
N100	3.75	3.56	3.13	2.52	3.28	3.25	67.53	54.13	0	0
N100 : P15	4.04	3.92	3.80	4.30	4.60	4.13	112.89	68.87	27.08	0
N100 : P15 : Zn5	5.20	4.90	3.90	4.30	5.00	4.66	140.21	77.67	0	12.83

**F1 – F5 indicate farmers; NUE = Agronomical N use efficiency*

- ß%f£ ó„å"_cÐ1'• ÅcR³ðü9Ó4@Xdp.ÝÐÕs•—£°Zº aÂ#eó ßa3KcÄX¹ öWóÿ ß• ÛýrÓ $„å%†ðS_Œ7¯ÕÈq®º÷Xy¶ pÑ2ãDãfžþ#kÌØ™¥ c ¬†ÔâCß?LdpÑK¬M® ß°ÍÚ;›Ù"ƒêö3"õ¥%bŸ; Ôˆ”ÍÙ:›Ø".k¨j e} šì)Š–Øv“ŸažÜzÛMŠë¤°r ¦ ÿ@¡-ÅÑÝJV· ßkÌÙº÷@$´Ìjv =
- ßíNZøebÃ ¤ºí*‹ì‹ì ~–öW¸T'©æ7C¤r¯»(•4•õ Ór¯Uwƒ›§³ ,ê“ô=Ü=ŸÛyÚ;¢Å% ßð èj V·ÄØ9É4ZfÇì‡“Ð1I†Å$äÖt€}•¢oÐèôG¨j, “«·Ïkwü7C¤BÈìZf£¯»ÓtoÐR^¿ ßkÌÙ3™ÖâÉ9š¦¾ÊÖGÕl½®…´ L-=ž ¡-o ÔÛ<Ì-£Ò g•øYeq®ìMŸQN‹ì \™ú ß;›ü:wƒÌjË o‡N®?lxÙxÙ:› %Ï/íN{Ü=¢Ý º| H©ÖX 9šûÊ+ŒÆ³¼Ý`ùZ&xµ"{Ü

the advantage was more i.e. 67.5%, 112.9% and 140.2% with the application of the recommended dose of N (100 kg / ha) along with 15 kg P and 15 kg P + 5 kg Zinc per ha.

? The results also revealed that application of 15 kg P per ha helped in rice yield increase by 32.9% and 27.1% when combined with 80 and 100 kg N per ha, respectively. In other words, the agronomic use efficiency increased when N along with P and Zinc were used. Zinc contribution to rice productivity was near 13% at both level of N application. This on-farm demonstration helped farming community to understand the role of different nutrients, as balanced dosages, in increasing rice yield.

Transfer of technology- An innovative approach

Goodness of any technology alone is not a guarantee for its fast spread. Certain necessary conditions are needed to be fulfilled to ensure its speedy dissemination. Over 7-8 years of NEFORDS' working with farmers has helped NEFORD to evolve an innovative approach consisting of following steps to accelerate pace of technology transfer :

? **Characterization and delineation of growing environment :** Identification of appropriate niches facilitates targeted testing and dissemination of technologies. To scale up Swarna sub1, for example, we have specified submergence prone (12-15 days) villages/blocks in the districts of eastern UP by using satellite data and GIS (Fig. 4, Table 9). Obviously, the distribution of seeds of Swarna Sub1 in these villages will be a guarantee to its success. Drought-prone and salt affected areas are also being delineated to plan similar strategies.

? **Adding value(s) to the component technology and developing attractive packages** : The fact that Swarna Sub1 is a submergence tolerant rice variety and ensures high productivity even when submerged up to 15 days, does not guarantee its spread for two main reasons : (a) due to shortage of labor, farmers are reluctant to cultivate rice and (b) due to being a long duration (150 days) variety, farmers have to forego the Rabi crop in the following season. To overcome these problems, NEFORD evolved a way-out i.e. direct seeding of Swarna Sub1 as a labor-saving device in Kharif, followed by zero till sowing of a short duration heat tolerant wheat variety, like Halna in Rabi. The farmers readily accepted this package.

Fig. 4 : Characterization of submergence prone rice areas for targeted dissemination in block Fatehpur Mandaon (Mau)

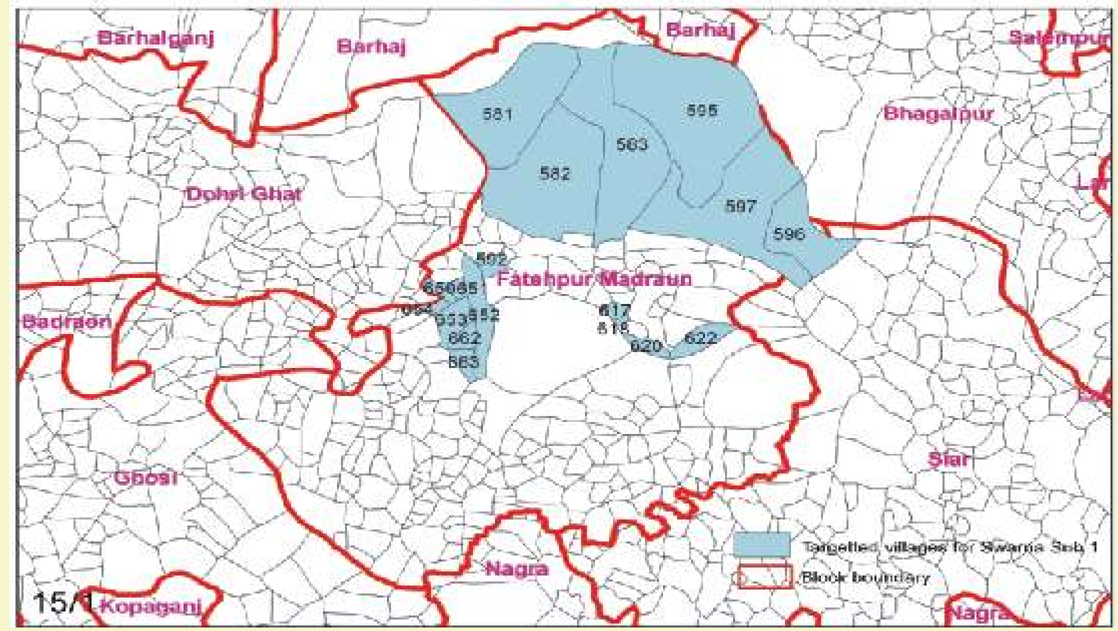


Table 9 : List of 18 villages identified for targeted dissemination of Swarna Sub1 in block Fatehpur Mandaon (Mau)

Village Code	Village Name
620	Bairiyadih
595	Baroha
617	Bhadaura Hoshiyar Rai
653	Chak Panday
596	Chakki Musadohi
581	Dharampur Bishunpur
582	Dubari
663	Harpalpur
662	Kaakaradih
592	Kabirajpur
650	Manauli
622	Kalyanpur
654	Chandan Patti
583	Molnapur
618	Mudadar Maniyar
597	Musadosi
651	Patti Dhusar
652	Sultanpur Barahgawa