

# **ANNUAL RESEARCH REPORT 2013-2014**



**Nimbkar Agricultural Research Institute,  
P.O. Box 44, PHALTAN-415523,  
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**September 2014**

# Nimbkar Agricultural Research Institute (NARI), Phaltan

## ANNUAL RESEARCH REPORT 2013-14

### Report of the President



I am very happy to place the annual research report 2013-14 of NARI before our readers. Significant research progress at NARI has been presented in brief. For more details of any subject, readers are encouraged to visit our [website](#) and/or write an [e-mail](#) to us.

One of the highlights of the past year was selection of our director Dr. Anil K. Rajvanshi for the [most distinguished alumnus award](#) from the University of Florida, Gainesville, USA. This was in recognition of his outstanding innovations in the field of renewable energy and rural development in the last 30+ years. He became the first Indian to be selected for this prestigious award. NARI is proud of his achievements and congratulates him for getting this award.

In the field of safflower NARI-H-23, a hybrid based on thermosensitive genetic male sterility was approved by the Central Variety Release Committee for commercial cultivation in the safflower growing areas in the country, while the high oil containing safflower variety NARI-57 was identified for release by the varietal identification committee. Details of both these are given in the report. Dr. Vrijendra Singh, our senior breeder and his colleagues deserve congratulations for these developments.

The adoption study of the 5-year project funded by ACIAR on “Improved productivity, profitability and sustainability of sheep production in Maharashtra through genetically enhanced prolificacy, growth and parasite resistance” found it to have had a considerable impact which is ongoing. The state of the art buck semen freezing laboratory has produced more than 14000 excellent quality buck frozen semen straws by the end of March 2014 in the existing facility itself while the new laboratory building is progressing. Dr. Chanda Nimbkar, Director and Dr. P. M. Ghalsasi, the Associate Director Animal Husbandry Division, NARI

and their colleagues are to be congratulated for their hard work for these and other exciting developments during the past year.

2015 has been declared as the International year of soils, by the 68<sup>th</sup> UN General Assembly. This is a welcome move for raising awareness on the importance of soil management as the basis for food systems, fuel and fibre production, essential ecosystem functions and ultimately allow for a better adaptation to climate change for present on and future generations. Mr. B. V. Nimbkar our founder and first president realizing the importance of soil conservation has been attempting over last several years to create awareness amongst civil society and decision makers about the enormity of soil erosion in India, its ill-effects and steps to be taken to reduce it. We hope to continue this work with great vigour during the next year.

As during every year we have received donations from many individuals for our work. For their generous donations we would especially like to thank Shri. B. V. Nimbkar who donated Rs. 2,75,000 and Smt. Jai Nimbkar who donated Rs. 2,00,000 for the grassland and dairy goat projects and Marico for a donation of Rs. 1,00,000 for holding the Annual Group Meeting on Safflower and Linseed at NARI in August 2013. Since April 2014 under the new companies law government of India requires every company having net worth or net profit of Rs. 500 crore or more or turnover of Rs. 1000 crore or more during any financial year to take up CSR activities. We hope some of the corporates will channel their funds next year to R&D NGOs like NARI.

Dr. N. Nimbkar  
President

September 9, 2014

## AGRICULTURAL RESEARCH

### **SAFFLOWER**

#### **All India Coordinated Research Project (AICRP) on Oilseeds (Safflower)**

**Funding agency :** Indian Council of Agricultural Research (ICAR), New Delhi.

**Scientists :** V. Singh, Ph.D., S. A. Khedekar, Ph.D., M. B. Deshpande, M.Sc.

**Technical staff :** M. Y. Patil, M.Sc., A. M. Shitole, M.Sc., M. R. Jadhav, M.Sc. S. V. Choudhari, B.Sc., S. P. Lokhande, B.Sc., S. S. Ghadage, B.Sc., R. G. Randive, N. C. Thorat, M. G. Shirke, Rima Jadhav

NARI is one of the centers of All India Coordinated Research Project (AICRP) for safflower Research under limited irrigation since 1980. The major objectives of safflower improvement at NARI have been to develop high-yielding and high oil-producing spiny and non-spiny varieties and hybrids with in-built resistance to wilt (*Fusarium oxysporum*), in addition to development of suitable agro-production and crop protection technologies for growing safflower under limited irrigations.

**Research Highlights :** The major highlights of safflower programme during 2013-14 are furnished below :

#### **Summer 2013 :**

Summer season was used for maintenance of thermosensitive genetic male sterile lines in safflower. During summer 2013, 98 selections of thermosensitive genetic male steriles lines were maintained for their further screening and utilization in hybrid development in safflower.

**I. Organization of Annual Group Meeting of Safflower and Linseed :** The major highlight of the year in safflower was the successful organization of Annual Group Meeting of Safflower and Linseed during August 29-31, 2013 at the Institute. The annual group meeting was attended by over 80 scientists and extension

workers of the two crops from different centers in the country. Dr. A. K. Rajvanshi, Director,



NARI welcomed the delegates and expressed his gratitude to ICAR for conducting this first group meeting at Phaltan. He stressed the importance of precision agriculture and its feasibility in safflower and urged the scientists and engineers to come together for achieving precision in agriculture to enhance the productivity. Dr. K. S. Varaprasad, Project Director, presented the progress of work done in safflower during 2012-13. Dr. Karam Hussain, Principal Scientist, PC Unit (Linseed), presented the research highlights of linseed for 2012-13. The Chief Guest, Dr. B. B. Singh, Assistant Director General (O&P) complimented NARI for holding the workshop and informed the delegates that India is importing oil worth Rs. 60,000 crores annually and our oilseed production meets only 45% of the oil demand domestically. He stressed on the requirement for doubling the production of oilseeds from the available land, which is a great challenge to the oilseeds researchers across the country.



chairperson's address, Dr. N. Nimbkar, President NARI, emphasized that we should learn from other countries and other crops about information that can be applied to safflower. She referred to the success of System of Rice Intensification (SRI) and urged the scientists to explore the system of crop intensification in

safflower and linseed. She also emphasized the importance of conservation agriculture and to study its role in increasing safflower production in India. During the 3-day duration of the group meeting, disciplinewise technical programme for implementation during 2013-14 for each crop was formulated and thoroughly discussed.

- 1. Release and notification of thermosensitive genetic male sterility (TGMS)-based hybrid NARI-H-23 for commercial production :** The TGMS-based safflower hybrid NARI-H-23 has been approved for notification and commercial cultivation in the safflower growing areas in the country by the Central Variety Release Committee in a meeting held in February 2014 at New Delhi. The major advantage of TGMS-based hybrid NARI-H-23 over Genetic Male Sterility (GMS)-based hybrid NARI-H-15 is that it overcomes the hybrid seed production difficulties encountered in GMS-based hybrids, thus making its hybrid seed production commercially feasible. NARI-H-23 recorded seed yield at par with that of NARI-H-15, however it gave 11.22% increase in oil yield over

NARI-H-15. NARI-H-23 has 35% oil in the seed and to the best of our knowledge is the first TGMS-based hybrid recommended for commercial cultivation in safflower anywhere in the world.

2. **Identification of high oil safflower variety NARI-57 for release :** Another very important accomplishment of safflower programme at NARI was the identification of high oil containing safflower variety NARI-57 for release by the varietal identification committee in their meeting held during annual group meeting of safflower and linseed at this Institute on August 29, 2013. The most important trait of this variety is that it contains an average oil content of 36.6% as compared to 28-32% in other released varieties. NARI-57 gives seed yield on par with the national check A-1. However NARI-57 out-yielded A-1 by 18.36% for oil in coordinated trials conducted over locations and years. In addition to giving high oil yield, it is also highly resistant to wilt as compared to national check A-1.
  
3. **Identification of male sterility maintainer genotypes for cytoplasmic male sterility in safflower :** Four sib-mated crosses made between male sterile plants and four derivatives of a genotype exhibited male sterility ranging from 87 to 96%, indicating thereby the existence of fertile cytoplasm in the pollinator parent. The male sterile plants of the sib-mated crosses were further maintained by pairwise crossing with the individual plants of the concerned pollinator parent in order to make the CMS line uniform for different traits and to identify the most promising combinations for further multiplication and utilization in hybrid development in safflower.
  
4. **Evaluation of short duration safflower in comparison to normal safflower under different spacings**



A preliminary investigation to assess the potential of short duration safflower in different plant spacings under rainfed conditions on poor soils as compared to regular safflower revealed that short duration safflower gave seed yield at par with the regular variety under normal spacing of 45 X

20 cm between rows and plants. The seed yield of short duration variety gradually increased over regular safflower as the spacing between rows and plants was decreased. The short duration genotype recorded 20% increase in seed yield over regular- duration safflower at a spacing of 30 X 10 cm between rows and plants respectively. This thereby suggested that on poor soils short duration safflower is more profitable than the regular safflower.

**5. Identification of safflower genotype producing single-headed plants :**

Derivatives of a genotype were identified as producing single-headed plants. Wide variability for number of flowers per capitulum and seed setting has been noticed in single-headed plants. Number of flowers or seeds in single-headed plants ranged from nil to 55. There is also a wide variability for seed filling in the seeds obtained from such plants. The causes of low seed setting and seed filling need to be investigated in addition to ploidy of single-headed plants in safflower. The height of single-headed plants was noticed to be at par with their multi-headed regular counterparts. These plants have been successfully crossed with the regular safflower having specific traits. The crosses made with the single-headed plants will be subjected to study of inheritance of single-headedness in safflower. The single-headed plants with capitulum fully filled with filled-up seeds would be of great significance in developing single-headed safflower suitable for production under different cropping systems and seasons in traditional and non-traditional areas in the country.



**6. Crossing programme :** Eighteen crosses using 18 genotypes as male parents and one TGMS and two CMS lines as female parents were produced during winter 2013-14 in order to develop a high yielding hybrid in safflower.

Sufficient seed was produced for each cross to evaluate them in a replicated trial in winter 2014-15.

**7. Early and advanced generation selections :**

- (a) Six F<sub>2</sub> crosses comprising of one high oleic parent in each cross were raised during the season. About 100-150 desirable plants were selected from each cross to further advance them for evaluation in subsequent years so that the most desirable selection could be identified and released as a variety. Selection will also be made for high oleic acid types among the individual plants harvested separately to develop high oleic acid variety in safflower.
- (b) Ninety two short duration F<sub>5</sub> selections were assessed for seed yield and other traits during the season and 14 of them recorded relatively high seed yield.
- (c) Four hundred nineteen F<sub>6</sub> high oil selections were evaluated for seed yield and its components. This resulted in identification of 80 F<sub>6</sub> selections giving higher seed yield than the best checks in the concerned trials.
- (d) One hundred forty two advanced generation lines which have stabilized were evaluated in five preliminary varietal trials for seed yield and its components during the season and of these 14 genotypes recorded higher seed yield than the respective best checks.

**8. Development of high seed and oil yielding safflower cultivar :** A promising safflower variety NARI-95 giving high oil and seed yield was evaluated in Initial Varietal Trial during 2012-13. It gave an increase of 3% in seed yield and 20% in oil yield over the check PBNS-12 under rainfed conditions. This is the first high oil-containing variety which has competed well for seed yield with the checks under rainfed conditions. NARI-95 contains 35% oil in its seed as compared to 28% in check PBNS-12.

In addition, four TGMS-based NARI hybrids evaluated in initial hybrid trial (IHT) showed that hybrid NARI-H-29 gave an average increase of 23% in seed yield and 26% in oil yield over hybrid check NARI-H-15 at national level. The hybrid NARI-H-27 outyielded the hybrid check NARI-H-15 by 21% and 24% for seed and oil respectively. The other NARI hybrids which also outyielded NARI-H-15 were NARI-H-28 by 19% for both seed and oil and NARI-H-30 by 15 and 14% for seed and oil respectively. All the four hybrids were promoted to Advanced Hybrid Trial for further testing.

9. **Coordinated varietal trials :** Among the two coordinated varietal trials, out of the 27 entries in IVT, entry DSI-114 (DOR, Hyderabad) recorded the maximum seed yield of 1923 kg/ha which was followed by the entries PBNS-125 (1793 kg/ha), PBNS-12 (1617 kg/ha) and PBNS-122 (1614 kg/ha) all from Parbhani. In IH & AVHT, local check NARI-38 recorded the highest seed yield of 1457 kg/ha which was followed by the entries AKS-326 (1216 kg/ha) and DSH-250 (1211 kg/ha).
  
10. **Seed production of safflower varieties and hybrids :** NARI has produced 250 Kg seed of TGMS-based safflower hybrid NARI-H-23, 20 kg seed of NARI-H-15 and 50 kg seed of NARI-NH-1. In addition to this 50 kg seed of safflower variety NARI-6 was also produced during the season.

## II. AGRONOMY

1. **Comparative productivity, profitability and resource use of non-spiny safflower to other rainfed rabi crops/systems :** The results of the trial showed that among the different sole crops evaluated, sole sorghum with cultivar Phule Yashoda recorded the significantly highest seed yield of 3997 kg/ha. Among the safflower varieties, the cultivar A-1 recorded the significantly highest seed yield of 1424 kg/ha. The safflower hybrid NARI-NH-1 recorded net returns of Rs. 103536/ha from both seed and petal which were at par with the highest returns from sole-sorghum (Rs. 108657/ha) and were followed by chickpea (Rs. 84612/ha) which was on par with the non-spiny safflower variety NARI-6 (Rs. 73432/ha). However this benefit from non-spiny safflower can only be obtained when the market has been developed for safflower petal. Sole sorghum, sole chickpea and chickpea + safflower gave the significantly highest benefit:cost ratio exceeding 4.
  
2. **Effect of temperature on oil content and oil yield of safflower :** The results of the trial showed that among the entries evaluated, A-1 sown on October 12 and November 15, recorded the significantly highest seed yield, biological yield, gross returns, net returns and benefit cost ratio. For harvest index A-1 planted in November was found to be significantly better. For biological yield A-1 planted on October 31 and November 15 was on par with that planted on October 12 as also NARI-57 planted on the same date.

**3. Assessment of suitable plant population for crop diversification :** The results of the trial showed that differences due to different spacings were significant for seed yield and other yield contributing characters indicating thereby that increase in the spacing between rows affects the seed yield in safflower adversely. In general, close spacings exhibited numerical superiority in seed yield over the wider spacings under irrigated conditions. The differences due to main plots i.e. varieties were significant for seed yield. The significantly highest seed yield of 1945 kg/ha was recorded for the variety NARI-38 planted at 45 X 20 cm spacing and was on par with NARI-38 sown at a spacing of either 30 X 20 cm (1824 kg/ha) or 60 X 20 cm (1790 kg/ha). Both the varieties showed considerable reduction in seed yield when spacing between rows increased from the recommended one i.e. 45 cm. Variety NARI-38 may be sown at 30 to 60 cm row spacing after confirmation of the present findings.

### III. PLANT PATHOLOGY

- 1. Survey of safflower diseases :** According to the survey of safflower diseases conducted in Satara and Sangli districts in winter 2013-14, in almost all the fields surveyed, the *Alternaria* leaf spot incidence was found to be more than that of *Fusarium* wilt. The *Alternaria* disease grade ranged from 0 to 7 in irrigated crops, while the early sown rainfed crop exhibited disease grade ranging between 1 to 3. None of the farmers of any of the villages applied any fungicidal sprays except those of Wagesher phata and Sonawadi in Phaltan taluka of Satara district. The incidence of wilt was occasional and of low intensity.
- 2. Confirmation of host resistance against major diseases (*Alternaria* leaf spot) :** Nine Germplasm Maintenance Unit (GMU) entries along with susceptible check Manjira and A-1 were screened for resistance against *Alternaria* leaf spot disease. All the test entries showed lower disease score than the susceptible check Manjira. The entry GMU-5094 was categorized as tolerant, since it showed percent disease intensity of 19.63%. However, rest of the entries were categorized as susceptible.
- 3. Confirmation of host resistance against major diseases (wilt) :** In all, 10 entries comprising of nine GMU and one susceptible check Nira, were screened against wilt. The susceptible check Nira showed 100% wilting in it. None of the entries screened gave resistant reaction to wilt and all of them were characterized as highly

susceptible. Among the entries screened, the entry GMU-5016 recorded the minimum wilting of 54.55%.

4. **Screening of selected elite material against *Alternaria* leaf spot :** The trial comprised of 38 entries, including 27 of IVT, nine of IH-AVHT and two checks, viz. Manjira--*Alternaria*-susceptible check (SC) and HUS-305--*Alternaria*-tolerant check (TC). The screening of elite lines against *Alternaria* leaf spot revealed that all the entries were found to be susceptible to the disease as none of the entries exhibited percent disease infestation < 20%.
5. **Screening of selected elite material against wilt :** The trial comprised of 37 entries, including 27 of IVT, nine of IH-AVHT and one susceptible check Nira. Out of all the entries evaluated, entry DSI-113 (DOR, Hyderabad) recorded the minimum wilting of 14% and has been categorized as tolerant to wilt. Twelve entries recorded wilting percentage between 21-50%. However, rest of the entries showed highly susceptible reaction to wilt. The susceptible check Nira exhibited a wilting percentage of 95%.

## **SWEET SORGHUM**

### **All India Coordinated Sorghum Improvement Project (AICSIP)**

**Funding agency :** Indian Council of Agricultural Research (ICAR), New Delhi

**Scientists :** N. Nimbkar, Ph.D., B. C. Nandeshwar, Ph.D., M. M. Patil, M.E.

**Technical staff :** V. A. Bhagwat, M.Sc., C. S. Khore, M.Sc., V. R. Jagdale, M.Sc., B. D. Pandit, M.Sc., S. A. Khalate, B.Sc. A. R. Gholap, A. A. Dhaygude,

NARI is one of the centers of All India Coordinated Sorghum Improvement Project (AICSIP) for sweet sorghum research since 2009. The program is monitored by the Directorate of Sorghum Research (DSR), Hyderabad, which is the central agency under ICAR to work on all aspects of sorghum research and development throughout India. The main objective of the AICSIP centre at NARI is to develop high sugar and biomass-yielding hybrids and cultivars giving high yield of good quality grains with the help of collaborative multilocation testing and facilitate the production of genetically pure seeds for the farmers.

**Major thrust of R & D under AICSIP at NARI centre :**

1. Development of sweet sorghum varieties and hybrids which yield high biomass, sugar and grain.
2. Development of high brix CMS lines.
3. Development of shoot-fly tolerant sweet sorghum restorer and maintainer lines.
4. Identification of promising lines for quality syrup production.
5. Quality improvement of syrup and also enhancing its shelf-life.
6. Development of high grain-yielding cultivars for post-rainy (winter season).

The investigations carried out during the year under this project are described below.

**Kharif (Rainy season) 2013 :**

**MS conversion programme**

In CMS development programme, a total of 36 pair-wise crosses were evaluated during Kharif 2013. Among the 37 progenies, again 66 pair-wise crosses were made and 33 promising combinations were advanced to Rabi 2013-14 season for evaluation.

**R line development programme**

In R line development programme diallel mating system was followed to make different crosses using parents having desired traits, in previous years. All the progenies in different generations were evaluated for plant height, total biomass, stripped stalk weight, juice yield, brix of juice, total sugar index and grain yield.

1. One hundred thirty two F<sub>5</sub> progenies evolved from six different families evaluated in Kharif 2013 were subjected to single plant selection. In all, 197 single plant selections based upon high biomass, brix of juice and grain yield were made in the promising families.
2. In F<sub>7</sub> generation, 20 progenies evolved from six promising crosses were evaluated during Kharif 2013. The best among them performed as follows :

Sr. No.	Line	Juice brix (%)	Total sugar index (T/ha)	Grain yield (q/ha)	Shootfly damage (%)	Stem borer incidence (%)
1.	DC-32-31	19	3.34	2.01	36.67	16.87
2.	CSV-24-SS (Check)	17	1.71	0.43	59.93	23.74

3. The DSR had supplied F<sub>2</sub> populations to all the centers in Kharif 2010 under network breeding programme and this material has been advanced to F<sub>7</sub> generation at NARI centre.

Thirty four advanced F<sub>7</sub> progenies evolved from two different crosses were evaluated during Kharif 2013. Out of these, 10 lines showed significantly higher total biomass and juice brix than the check CSV-24-SS. The best among them performed as follows :

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)
1.	10R-SS-20-61-8-5	24.0	20.71
2.	10R-SS-20-61-1-5	23.33	20.27
3.	10R-SS-19-16-5-2	20.67	19.76
4.	CSV-24-SS (Check)	19.67	17.04

### **Pre-varietal trials (PVT)**

Fifty-five uniform lines which are almost stable were tested as PVT entries along with two national checks viz., CSV-19-SS and CSV-24-SS in four different trials.

1. In the first trial, out of the 13 lines evaluated almost all had numerically greater values than the checks for plant height (cm), stripping % and brix of juice. The best among them performed as follows :

Sr. No.	Line	Juice brix (%)	Grain yield (q/ha)
1.	D-91-29-4	22.83	1.41
2.	D-91-9-2	21.83	4.85
3.	D-91-9-5	22.17	2.38
4.	D-91-29-2	20.50	2.29
5.	CSV-24-SS (Check)	19.0	1.62

2. In the second trial, out of the 15 lines evaluated only four lines recorded greater plant height than the check where line D-141-34 showed significantly greatest value for plant height (274.73 cm) with the check CSV-19-SS having plant height of 248.60 cm. The best lines performed as follows :

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Juice yield (T/ha)
1.	D-18-7-10-2	19.17	25.17	4.79
2.	D-77-15-1	19.33	21.08	5.24
3.	D-141-33	18.5	24.48	4.46
4.	D-18-7-8-1	19.83	22.44	4.64
5.	CSV-24-SS (Check)	18.5	20.49	4.21

Similarly line D-49-53 recorded the highest grain yield (7.10 q/ha) along with a higher brix of juice (19.0%) than the check CSV-24-SS (Grain yield 2.22 q/ha and brix of juice 18.5%).

3. In the third trial again 15 entries were evaluated out of which almost all the lines reported greater plant height than the check CSV-24-SS (233.14 cm) with the line D-91-60 reporting maximum plant height (327.40 cm). The entries giving good performance were as follows :

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)
1.	D-94-74	20.50	32.35	21.54
2.	D-91-9	21.83	17.04	3.21
3.	D-91-35	21.83	12.25	1.49
4.	CSV-24-SS (Check)	17.83	21.64	17.48
5.	CSV-19-SS	18.17	28.88	17.83

4. In the fourth trial, 12 lines were tested. The entries giving good performance were as follows :

Sr. No.	Line	Juice brix (%)	Plant height (cm)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Grain yield (q/ha)
1.	D-23-28-10-3-4	19.2	354.67	26.51	7.66	1.42
2.	D-34-20-2-5	20.7	286.67	30.10	20.23	3.59
3.	(D-31)-44-3-3	21.8	248.87	8.27	6.19	5.10
4.	(D-31)-44-3-11	21.8	270.60	10.45	3.70	6.04
5.	CSV-24-SS	17.8	240.27	25.21	13.97	0.96

### **B line development programme (Network breeding)**

B line development programme at the center was initiated during Kharif 2010 and the original material was supplied by the DSR under network breeding programme. Total of 55

$F_6$  progenies produced from seven different crosses were evaluated in three different trials (Groups A, B & C) during Kharif 2013

1. In the first trial where 15  $F_6$  entries were evaluated the promising lines were as follows :

Sr. No.	Line	Stripped stalk weight (T/ha)	Grain yield (q/ha)	Juice yield (T/ha)
1.	10B-AGR-46-45-2-4	7.18	8.16	2.31
2.	10B-AGR-46-52-5-1	6.67	0.58	1.73
3.	10B-AGR-46-86-3-5	5.88	3.18	1.06
4.	296B (Check)	4.66	1.75	1.28

2. In the second trial, among the 17  $F_6$  progenies evaluated the following were found to be the best.

Sr. No.	Line	Plant height (cm)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	10B-AGR-47-34-1-1	225	8.03	3.03
2.	10B-AGR-48-1-5-3	169.54	9.05	2.27
3.	10B-AGR-48-14-4-2	175.57	8.66	2.30
4.	296B (Check)	176.33	7.06	1.24

3. In the third trial the following lines were found to be most promising :

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	10B-AGR-61-37-3-2	14.17	14.64	5.42	0.89
2.	10B-AGR-61-36-1-3	14.50	12.77	8.18	3.47
3.	10B-AGR-66-49-3-2	16.0	11.95	4.20	0.56
4.	10B-AGR-61-8-2-6	15.7	10.40	3.75	0.79
5.	10B-AGR-66-49-3-1	15.7	12.21	4.20	0.90
6.	296B	15.0	13.04	5.41	1.38

### **Station hybrid trials**

A total of 38 CMS-based hybrids along with two hybrid checks viz, CSH-22-SS and Madhura were assessed in three different trials for high biomass, brix of juice and grain yield in Kharif 2013 season.

1. In the first trial, out of the 17 hybrids evaluated hybrid SSRH-211 recorded the maximum biomass of 28.85 t/ha as against 25.77 t/ha in the check CSH-22-SS.

Similarly, four hybrids SSKH-195 (19%), SSKH-202 (17.17%), SSKH-214 and SSKH 215 (both 17%) reported significantly higher juice brix than both the checks CSH-22-SS and Madhura (both 16.67%).

2. In the second trial, seven hybrids were assessed of which four hybrids reported higher grain yield than the check CSH-22-SS (2.53 q/ha) with SSRH-219 recording significantly highest grain yield of 6.30 q/ha.
3. In the third trial, out of the 14 hybrids assessed three hybrids SSKH-229 (30.67 t/ha), SSKH-239 (29.99 t/ha) and SSKH-227 (29.27 t/ha) gave significantly higher total biomass than the check CSH-22-SS (24.59 t/ha).

#### **AICSIP trials :**

Three trials were allocated and they were successfully conducted. These trials are:

1. **IAVHT trial** - Entries NARI-SSH-7, RSSH-18, ICSV-25341 and SS-2012 were the best in this particular trial for biomass, juice yield, juice brix and total sugar index (TSI)
2. **High biomass trial** - In this trial, entries RSSV-325, RSSV-351, RSSV-369 and RSSH-50 gave high biomass, juice yield, juice brix and total sugar index.
3. **Phenotyping kharif sorghum germplasm for mid-season drought adaptation** - In this trial SSRK-13-8 and SSRK-13-39 exhibited drought tolerance.

#### **Rabi (Post-rainy season) 2013-14**

##### **MS conversion programme**

In CMS development programme, a total of 33 pair-wise crosses were evaluated during Rabi 2013-2014. Among the 33 progenies, same 33 crosses were advanced to Kharif 2014 season for evaluation.

### **R line development programme**

In R line development programme diallel mating system was followed to make different crosses using parents having desired traits, in previous years. All the progenies in different generations were evaluated for the characters plant height, total biomass, stripped stalk weight, juice yield, juice brix and grain yield.

1. One hundred fourteen F<sub>5</sub> families along with their 12 parents were evaluated in Rabi 2013-14 and were subjected to single plant selection. In all, 108 single plant selections based upon high biomass, juice brix and grain yield were made in the promising families.
  
2. In F<sub>8</sub> generation, 22 progenies of five promising crosses were evaluated during Rabi 2013-14. Among them the best entries were as follows :

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	F <sub>8</sub> (DC-26)-17	20	52.06	35.75	13.83
2.	(D-118)-69-4	20	52.32	36.90	12.90
3.	CSV-19-SS (Check)	19	35.67	26.79	7.30
4.	CSV-24-SS (Check)	14	41.52	25.08	7.48

3. The F<sub>2</sub> populations received from DSR under network breeding programme in 2010 have been advanced to F<sub>8</sub> generation at NARI Centre. Thirty four F<sub>8</sub> progenies selected from two different crosses were evaluated during Rabi 2013-14. Out of these, 11 lines showed numerically higher total biomass, stripped stalk weight, juice yield and juice brix than the check CSV-24-SS. Line 10R-SS-20-16-5- (biomass 43.73 t/ha, stripped stalk weight 31.80 t/ha, juice yield 11.37 t/ha and juice brix 22.0%) showed numerically greatest performance as against the check CSV-24-SS. (biomass 37.43 t/ha, stripped stalk weight 21.75 t/ha, juice yield 8.41 t/ha and brix 17.0%).

### **Pre-varietal trials (PVT)**

Total of 55 different uniform lines were evaluated as PVT entries in four different trials and their performance was assessed for different traits

1. In the first trial, out of the 13 lines which were evaluated six lines produced superior performance for the characters as mentioned below.

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	(D-91)-67-4	21	55.62	40.35	22.87
2.	CSV-19-SS (Check)	20	37.78	29.16	10.96
3.	CSV-24-SS (Check)	16	32.94	19.71	9.19

2. In the second trial, out of the 15 lines evaluated, line (D-49)-53 gave numerically superior performance to the checks as given below.

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	(D-49)-53	19	48.34	34.0	16.31
2.	CSV-19-SS	18	38.21	27.2	11.87
3.	CSV-24-SS	13	39.67	20.65	14.39

3. In the third trial, out of the 15 lines evaluated, two lines viz., (D-23)-28-10-3-4 and (D-34)-21-3-3 showed numerically better performance as given below.

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	(D-23)-28-10-3-4	22	58.59	37.44	17.40
2.	(D-34)-21-3-3	20	58.42	32.31	15.22
3.	CSV-19-SS	21	37.78	27.45	13.23
4.	CSV-24-SS	18	33.18	19.26	8.28

4. In the fourth trial out of the 12 lines evaluated, four lines produced numerically superior performance as given below.

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	(D-91)-52	23.0	59.81	42.25	17.67
2.	CSV-19-SS	14.4	42.17	28.18	8.22
3.	CSV-24-SS	13.0	39.44	21.75	7.37

### **B line development programme (Network breeding)**

B line development programme at the center was initiated during Kharif 2010. A total of 55 F<sub>6</sub> progenies produced from seven different crosses were evaluated in an un-replicated manner during Rabi 2013-14.

Among the 55 entries evaluated, 13 lines were found to be numerically superior to both the checks 296 B and IS 2312. The performance of the best lines was as follows :

Sr. No.	Line	Juice brix (%)	Biomass yield (T/ha)	Stripped stalk weight (T/ha)	Juice yield (T/ha)
1.	10B-AGR-47-34-1-1	20.5	59.96	40.33	15.24
2.	10B-AGR-48-1-5-1	20.0	54.30	38.14	14.19
3.	10B-AGR-47-63-3-3	20.0	49.63	34.22	12.45
4.	296B (Check)	13.0	18.73	9.99	2.98
5.	IS-2312 (Check)	13.5	30.78	15.02	6.04

#### **Number of crosses (trait-based) successfully made (with pedigree)**

##### **Line x Tester mating design**

In the hybridization programme the superior germplasm and IS lines which were identified as having higher grain yield potential and high biomass were planted in a line x tester mating design (Kempthorne, 1957). Two sets were made with 16 different germplasm and IS lines. In both the sets five lines were used as female parents and three superior lines were used as male parents. Details of the materials which were used in hybridization programme are given below.

<b>First set (within germplasm lines)</b>	<b>Second set (Germplasm x IS lines)</b>
<b>1. Lines (Females)</b>	<b>1. Lines (Females)</b>
1. NARI- SS-21-1	NARI- SS-29
2. NARI- SS-40	NARI- SS-76
3. NARI- SS-79	NARI- SS-135
4. NARI- SS-191	NARI- SS-137
5. NARI- SS-230	NARI- SS-178-1
<b>2. Testers (Pollinators)</b>	<b>2. Testers (Pollinators)</b>
NARI-SS-53	IS-38465
NARI-SS-128	IS-19740
NARI-SS-203	IS-8918

### **Maintenance and seed production**

1. 273 gemplasm lines were maintained during Rabi season 2013- 2014.
2. 141 IS lines were maintained during Rabi season 2013-2014.
3. Seed production of two promising CMS-based hybrids *viz.*, NARI-SSRH-19 and NARI-SSRH-20 was undertaken. Sufficient amounts of seed of these hybrids were obtained for conducting an evaluation trial. NARI-SSRH-20 has been tested in an AICSIP trial during Kharif-2013 and promoted for testing in the advanced trial (AHT-I).
4. Seed production of three promising selections *viz.*, (D-102)-12, (D-94)-74, and (D-118)-34 was undertaken. The selections (D-118)-34 and (D-94)-74 were tested in AICSIP trials during Kharif 2013 and have been promoted for second year of testing in (AVT-I) and (AVT-II) respectively.

### **AICSIP trials :**

Two AICSIP trials were allocated and successfully conducted at the centre during the season as follows.

a. **IVHT-SS Trial (Evaluation of grain sorghum entries on shallow soils) :**

Entries, SPV-2238 (DSR), SPV-2234 (Rahuri) and Phule Anuradha (check) showed the best performance for grain yield on shallow soil under rainfed condition.

b. **IAVHT (Sweet sorghum) :**

Entries, **8006, 8052, 8060, 8103 and 8110** were found to be the best entries on the basis of total biomass, juice brix, juice yield and total sugar index.



**Sweet Sorghum Variety “D-94-74” developed by Nimbkar Agricultural Research Institute promoted for final year of multilocation testing in AICSIP programme for the year 2014-15**



**Grain Sorghum varieties developed**

## **GRASSLAND DEVELOPMENT**

**Funded Internally**

**Scientists :** Mr. B. V. Nimbkar, Dr. Nandini Nimbkar

**Technical staff :** Mr. S. V. Choudhari

During the previous year to multiply three entries of buffelgrass (*Cenchrus ciliaris*) planted in the nursery, some of the material was replanted in another plot in an 8.1 m x 22 m area per day. These three entries were Laredo (USA), CAZRI-75 (India) and Gayndah (Australia). The material from this multiplication plot was used for planting AHD's Lundy farm at Rajale and fodder demonstration plots at Vadjal, and NARI's Madhura farm at Jadhavwadi.

In April 2013, five entries received from the International Center for Biosaline Agriculture in UAE earlier sown in pots were transplanted into the nursery. They were PI 294595, PI 409295, PI 414513, Grif 1619 and MAF 74.

In September 2013, six entries sown in pots were transplanted into the nursery. They were CAZRI-358, CAZRI-75, *C. ciliaris* 2178, *C. setigerus*, seed collected from promising plant of *C. ciliaris* at Dhuldev and *C. ciliaris* from Tamil Nadu.

Also seed of “Cloncurry” received from the Central Fodder Seed Production farm of Government of India at Hessarghatta in Karnataka was sown in the nursery.

40 Kg seed of ‘Laredo’ collected from Madhura farm was dried and stored at Vadjal.

## **RENEWABLE ENERGY**

### **Highlights**

1. The project entitled “Kerosene Lanstove for rural areas” was completed and final report submitted to Department of Science and Technology (DST), New Delhi.
2. Dr. Anil K. Rajvanshi, the Director was chosen for the Distinguished Alumnus Award of University of Florida for his work in renewable energy. He became the first Indian to be selected for this prestigious award.

### **Projects**

#### **A. Kerosene Lanstove for rural areas.**

**Funded by** Department of Science and Technology (DST), New Delhi.

**Scientist :** Dr. Anil K. Rajvanshi

**Technical staff :** A. M. Pawar, D. B. Gadhave, K. S. Jagtap, B.Sc., A. S. Kadam, V. S. Ghadage, Rachel Nanette (Intern), Ashutosh Anand (Intern), Aniket More (Intern), Rittika Sen (Intern), Sunay Shah (Intern), Valentin Triquet (Intern)

The kerosene Lanstove was [successfully tested in 23 unelectrified huts](#) in five villages surrounding Phaltan. The project funded by DST ended in October 2013. The main findings of the project were :

1. Twenty five Lanstoves were manufactured in Pune and assembled at NARI workshop for testing their performance in rural households.



Twenty three Lanstoves were distributed in rural households in five nearby villages and tested for one year. The main purpose of this testing was to see the ease of operation and get feedback from rural people. Night visits were done to see the actual use of Lanstove for cooking and lighting and for collecting data.



2. The Lanstove was tested in 37 houses.

3. Total number of hours accumulated on Lanstoves were ~ 6900.

4. The '[Lanstove' \(Lantern cum stove\)](#)' developed for lighting and

cooking purpose works on the same principle as the Petromax lamps (pressurized kerosene lanterns with mantle). It has a pressurized cylinder of 7-9 liters kerosene capacity, a valve to regulate kerosene, a mantle lantern, a steam-based cooking vessel which runs on the heat of Lanstove flue gases.

5. The Lanstove produces power ranging from 1400 to 1800 Watts and light ranging from 3000 to 4000 lumens. The light is equivalent to that from a 100-200 W incandescent bulb.

Lanstove is therefore an excellent device for cooking and lighting. Carbon monoxide (CO) emission from kerosene Lanstove ranges from 1-7 ppm (near the person who is cooking on the Lanstove) even after 3-4 hours of use in huts. This is around 1% of CO emitted from biomass cookstoves. The particulates levels are only 15-20  $\mu\text{g}/\text{m}^3$  which is equivalent to that from LPG stoves.

6. Economic study was done to compare the cost of the Lanstove with an LPG stove. From this economic study it was concluded that kerosene Lanstove is less expensive than LPG, if cost of kerosene does not exceed Rs. 45/- per liter.
7. Life Cycle Analysis (LCA) study on Lanstove showed that it is nearly five times more efficient than electric cooking and lighting.
8. The lifestyle of some of the users changed substantially after they started using the Lanstove. They could save their valuable time which was till now wasted in collection of wood or other biomass and use it more productively. The children in these households were not studying earlier because of unavailability of light at night, but after getting the Lanstove they started studying well.

The Lanstove was well-accepted by the users. Some of the comments about it by the users were as follows :

- (1) The Lanstove is an excellent source of light. It is especially useful for children as they are able to study at night. A daughter in the family of Mr. Sathe is in the 10<sup>th</sup> standard. The Lanstove is very useful for her to study.
- (2) Mrs. Mohite told us that she was able to do her work on the sewing machine at night because of the Lanstove light.
- (3) The small children who never remained at home because of the smoke from the *chulha* now stayed home at night and completed their homework because of the Lanstove.

- (4) Mrs. Mane from Choudharwadi had a 4-5 month-old baby. When she was using the *chulha* for cooking, her baby kept on crying because of the smoke. However, this problem was solved when she started using the Lanstove.
- (5) The Pawar family from Vadjal used the Lanstove for both cooking and lighting. Now, the *chulha* is a standby for them. They told us that for small families of 4-5 people Lanstove is very good.
- (6) Mr. Rajendra Khilare told us that the Lanstove is very useful at night because it can be used to serve the dual purpose of cooking as well as lighting.
- (7) Most of the users liked the capability of Lanstove for cooking of rice, dal and vegetable, simultaneously and without burning of food. However, they faced some problems while making regular big *bhakari* and *chapattis*.
- (8) Both the Khilare and Mohite families have used the Lanstove for cooking chicken and claim that it was tastier than that cooked on the *chulha*.
- (9) Mrs. Kanade told us that because of the Lanstove, the problem of blackening of utensils is completely solved. Also, once the cooker is placed on the Lanstove, they can do other work while the cooking takes place. In case of the *chulha* she had to attend to the cooking continuously.
- (10) Mrs. Masugade told us that the Lanstove is very useful during the monsoon season as it solves the problem of fuel collection.
- (11) The children from Bhosale family told their parents that they will study only if there is a Lanstove in the house. These children initially were afraid of the Lanstove and would not allow their father to ignite it.
- (12) Mrs. Saste told us that she has successfully made *Puranpoli* (a Maharashtrian festive sweet) on the Lanstove. She now makes all the food on the Lanstove.

However, the biggest roadblock in the use of Lanstove was the availability of kerosene. According to the present rules each below poverty line (BPL) household is given only 5 litre

kerosene per month from the Public Distribution System (PDS) or ration shops. Our Lanstove uses close to 15 litres kerosene per month. Hence we got a special permission from the collector, Satara to increase the kerosene quota for the beneficiaries. Despite his instructions to this effect to the local PDS shops, they played truant and on one pretext or the other gave less kerosene to the beneficiaries. This is a major issue and biggest stumbling block in spread of Lanstove on large scale.

An article on this issue was [published in Current Science](#) and was widely carried by the mass media. There are indications that some progress has been made in recent times to make more kerosene available to BPL families.

### B. A simple soot measurement device

**Scientist :** Anil K. Rajvanshi, Ph.D.

**Technical staff :** Etienne Gayet (Intern)

Funded internally.

In order to measure soot (if any) from our Lanstove we developed a simple device to measure it. Presently measurement of soot in user huts has been done by researchers using sophisticated equipment. This includes collecting air samples from huts by costly air sampling devices. This soot-laden sample is then taken to a laboratory and passed through either infrared or laser particulate counters for measuring the total soot quantity and also the particle size of the soot. The procedure is tedious, costly and can neither be performed easily nor for a large number of households.

Thus a [simple method of measuring soot using a smart phone](#) has been developed.

The basic idea is to collect the soot on a metal plate (either stainless steel or mild steel) and then measure the reflection of light from it using a smart phone and correlate the reflection with amount of soot collected. Fig.1 shows the schematic diagram of the device. It is a very simple device which can be made in any small workshop.

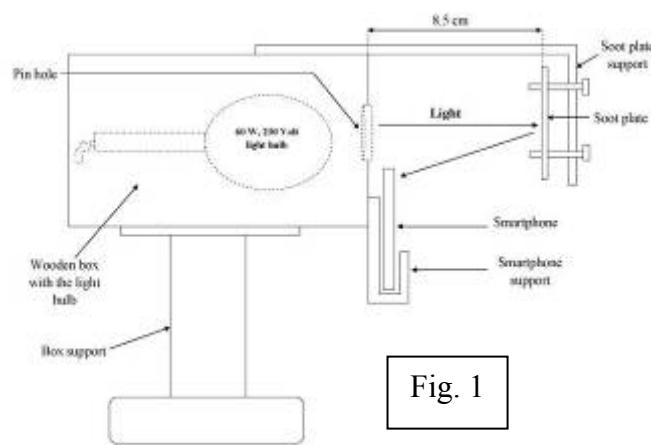
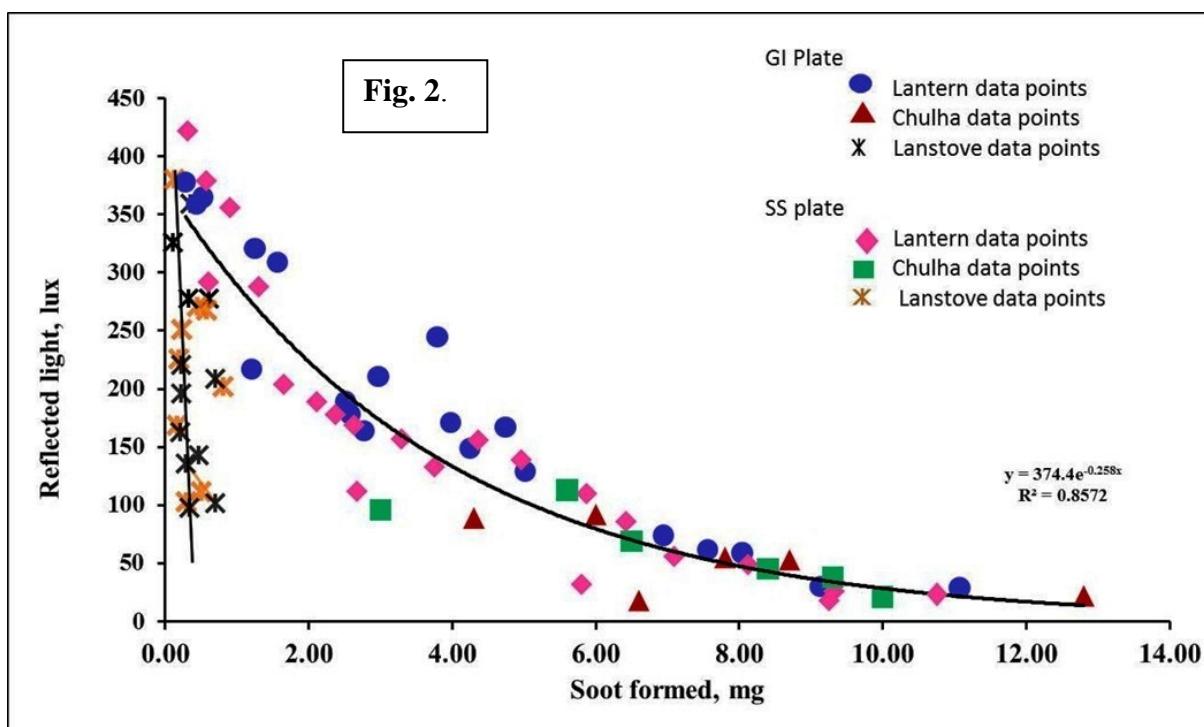


Fig. 1

Total soot entrapment and its measurement is a very good indicator of the indoor air pollution and is a much simpler and cheaper option than measurements of PM<sub>2</sub> or PM<sub>10</sub> particle sizes.

In order to test the reliability of this method and device the actual test data of smoke, during cooking, from *chulhas* (woodstoves) used in a hut was recorded. The plates were mounted close to the *chulha* (distance varying from 10-25 cm from its end) during the cooking operations which lasted for 1.5-2.0 hours. Six tests on different days were conducted. The plates were then brought back to the laboratory and their weights and reflections from them were measured. The data plotted is shown in Fig. 2 below.



The choice of keeping the plates at 10-25 cm distance from the *chulha* was dictated by the fact that women generally sit at these distances while cooking and hence particulates emission at this distance is a more useful indicator of the inhalation of smoke and pollutants.

The data from these tests also show that the total particulate emissions from the *chulhas* used in this study were in the range of 0.1 to 0.4 g/kg of wood used. This is much less than the values of 3-5 g/kg as reported in the literature. These higher values of particulates reported resulted since all the soot produced by the *chulhas* is captured in fancy collection devices and measured.

Nevertheless the good fit of all the data collected from *chulhas* using plates of different material attests to the efficacy of this simple method of soot measurement.

It is clear from Fig. 2 that the amount of soot production from the Lanstove is very small. The actual soot production was 1.8-2.5 mg/kg of fuel used which translates to 15-20  $\mu\text{g}/\text{m}^3$ . The average volume of huts used in our work was 25  $\text{m}^3$  and using the norm of one air exchange in two hours for such buildings (with one door and a small window), the amount of soot per volume of air was calculated. This volumetric particulate emission is equal to or lower than that measured in the air of some of the cleanest cities of the world, thus confirming the non-polluting nature of Lanstove.

We have not patented this device or the method and feel that it should be freely available so that soot production map of various cookstoves used in different regions of the world can be developed.

### C. Solar water sterilization

**Scientists :** Anil K. Rajvanshi, Ph.D., Smita Pingale, M.Sc.

**Technical staff :** Pablo Eulogio (Intern)

Funded internally.

NARI has developed the technology of sterilizing water by passing it through four layers of cotton sari cloth and then heating it to 60°C. Our laboratory study showed that filtered water heated to 50°C for 1 hour became potable and free of all coliforms.

This project is now being extended to use solar energy for heating the water so as to make it clean. Consequently tubular solar collectors have been used to heat 14 liters of water in the stagnation mode and this heated water is being tested microbiologically regarding its potability.

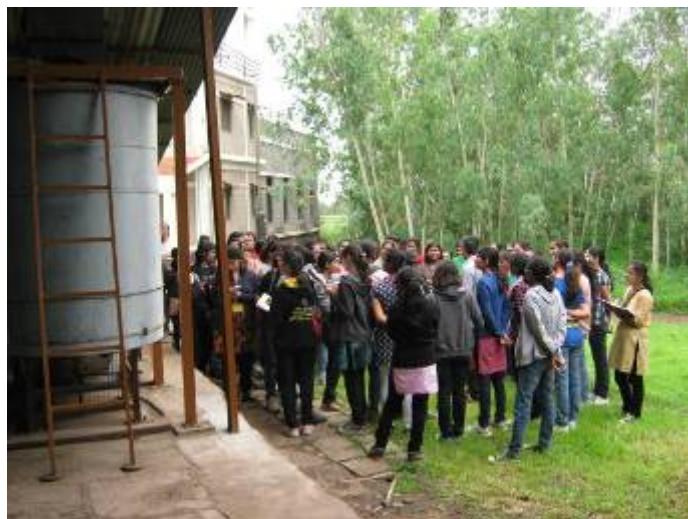
Test data for the last two months show that in Phaltan area the water can easily be made potable by this method. Rough estimates show that this solar system (14 liter capacity) will cost less than Rs. 1,500/-.



We plan to continue testing this setup for another 9-10 months to evaluate its performance during rainy days and winter season.

#### **D. Training of students on renewable energy**

Quite a number of students from various colleges like Cummins College of Engineering, Tata Institute of Social Sciences (TISS) and IIT Bombay, were given lectures on renewable energy at Bajaj Center for Sustainable Development. Lectures were also given to 35 women farmers from Andhra Pradesh who attended a  $\frac{1}{2}$  day course on renewable energy.



Besides the above, Dr. Rajvanshi has been giving lectures on renewable energy all over the country to students at various engineering colleges.

#### **E. Book on renewable energy work at NARI**

Work was also started to write the [human interest story of renewable energy research and development](#) at

NARI started in 1981. Dr. Rajvanshi is working on this book which is hoped to be completed by the end of 2014. Two chapters have been written and have been put on the NARI website.

## ANIMAL HUSBANDRY RESEARCH

### **Highlights :**

1. The adoption study of the project “Improved productivity, profitability and sustainability of sheep production in Maharashtra, India through genetically enhanced prolificacy, growth and parasite resistance”, funded by the Australian Centre for International Agricultural Research (ACIAR) and carried out by the Animal Husbandry Division (AHD), NARI from 2003 to 2008, was done by Prof. Stephen Walkden-Brown of the University of New England, NSW, Australia, on behalf of ACIAR. The study concluded that “The project was well implemented and has had considerable impact which is ongoing” It also said that “Lessons from the project include successful involvement of a dynamic NGO such as NARI as the key project partner.”
2. The ‘State of the art buck semen freezing laboratory’ funded by the Ministry of Agriculture, Government of India, is functioning from the old premises. The construction of the new laboratory building is in progress, using the funds we saved in the purchase of equipment.

Up to the end of March 2014, more than 14,000 excellent quality buck frozen semen straws were produced and about 10,000 straws were supplied to government and private Artificial Insemination (AI) centres and technicians for field AI. The average conception rate achieved on cervical AI of does on natural oestrus, using the semen produced in our laboratory, has consistently been more than 50% on our farms and as reported by private technicians. Dr. P. M. Ghalsasi, the Associate Director of AHD who is in charge of the laboratory, went to INRA, France in June 2013 to obtain further knowledge of buck semen freezing and AI technology as AI in goats is widespread in France and in use for a long time.

3. The Karnataka State Minister for Law, Justice and Human Rights, Parliamentary Affairs and Legislation, Animal Husbandry and In-charge Minister for Tumkur District, Mr. T. B. Jayachandra visited the AHD, NARI on 28-29 October 2013 and was very impressed with the AHD’s work, especially the highly productive ‘NARI Suwarna’ sheep. He prevailed upon his department and the Karnataka State Sheep and Wool Development Corporation to draw up a comprehensive programme for the ‘introgression of twinning genes into sheep in Karnataka through NARI Suwarna rams’ and because of the Minister’s dynamism, this programme is being implemented step-by-step. It has thus paved the way for the large scale use of the technology developed by the AHD, NARI for the benefit of sheep farmers in Karnataka.

The Minister’s visit to NARI was the result of the efforts of Dr. Mohammed Nadeem Fairoze, Professor, Department of Livestock Production and Management, Bangalore Veterinary College and Dr. G.M. Nagaraja, Assistant Director, Department of Animal Husbandry, Tumkur District, Karnataka State. We are grateful to them.

4. Our ties with Karnataka State became stronger when an MOU was signed on 28 May 2013 between the Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar and NARI for collaboration in sheep and goat production research.

5. Under the Osmanabadi goat field unit of the ‘All India Coordinated Research Project on Goat Improvement’ funded by the Indian Council of Agricultural Research, 723 adult does and their 1505 kids were recorded during 2013-14. Milk yields of 400 does were recorded about four times during the lactation. Animals with outstanding performance were identified and their progeny purchased for further dissemination for genetic improvement of village goats.
6. Dr. Pradip Ghalsasi visited Y. N. Antoniades and Sons Ltd. [breeders and exporters of Damascus (Shami) goats] at Limassol, Cyprus from 23-31 July 2013 to freeze 200 semen doses of Damascus bucks in their semen freezing Centre. These doses were frozen for Nimbkar Seeds Pvt. Ltd., Phaltan, Maharashtra who placed an order of 200 doses and wanted to obtain good quality semen. Damascus is an outstanding tropically adapted dairy goat genetically improved in Cyprus and has the potential to bring about substantial increases in the milk yield of local goats.

#### **Ongoing projects :**

##### **Project I. Increasing profitability of sheep production by genetic improvement using the *FecB* (Booroola) mutation and improved management**

###### **Funded internally.**

**Scientists :** Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi

**Technical staff :** Ms. Padmaja Ghalsasi, Mr. Rupsing Khanvilkar, Mr. Dilip Bhandare

A new strain of Deccani sheep called ‘NARI Suwarna’, with about 60% higher lamb production due to higher proportion of twinning than Deccani sheep has been developed. The growth rate, mothering ability and conformation of the new breed were improved by the introduction of the Madgyal breed and selection. The breed has been disseminated to shepherds in Maharashtra, Andhra Pradesh and Karnataka and they are profiting from its use.

We now have a selected nucleus flock of **92 *FecB*<sup>BB</sup> ewes** (homozygous for the *FecB*<sup>B</sup> allele), **218 *FecB*<sup>B+</sup> ewes** (heterozygous for the *FecB*<sup>B</sup> allele) **and 59 non-carrier adult ewes**, making a total of 369 ewes. In addition, there are 98 young ewes (**34 *FecB*<sup>BB</sup> and 64 *FecB*<sup>B+</sup>**) that are 3 to 10 months old. We have 35 breeding rams, comprising of 13 *FecB*<sup>BB</sup>, 20 *FecB*<sup>B+</sup> and 2 non-carrier Madgyal rams. Some of these will be sold as breeding rams. Additionally, there are 86 young (3 to 10 months old) selected rams (35 *FecB*<sup>BB</sup> and 51 *FecB*<sup>B+</sup>). These animals are either NARI Suwarna (with only Deccani and Madgyal breed proportion and less than 10% Garole breed proportion) or NARI Composite (with additional Awassi and/or Bannur breed proportion). Madgyal rams are being used in NARI’s breeding programme to improve the physical appearance and conformation of crosses in such a way as to make them more desirable to local smallholder sheep owners. Madgyal or Vijapuri is a breed from southern Maharashtra which is a tall breed with a faster growth rate than Deccani and is preferred by shepherds in the Phaltan area and many other areas of Maharashtra.



Some ewes in the NARI Suwarna nucleus flock at NARI's Lundy farm near Rajale  
in large

**Table 1. Details of AI programs carried out at NARI's Lundy farm, Rajale in Feb-Mar, July and Nov-Dec 2013**

Particulars	Ewe's FecB genotype			
	<i>FecB</i> <sup>BB</sup>	<i>FecB</i> <sup>B+</sup>	<i>FecB</i> <sup>++</sup>	Total
Ewes available for breeding	88	217	75	380
Ewes inseminated artificially (AI)	78	181	64	323
Ewes conceived (first and second AI + Natural service)	64	156	53	273
Conception rate to first AI (%)	82.0	86.2	82.8	84.5
Pregnant ewes died	3	1	0	4
Ewes aborted	4	1	0	5
Ewes lambed with at least one live lamb	51	145	53	249
Ewes lambed with all lambs stillborn or died soon	6	9	0	15
Total live lambs born	80	240	56	376
Live lambs born per ewe lambed with at least one live lamb	1.57	1.65	1.06	1.51
Live lambs born per ewe lambed or aborted or with all lambs stillborn	1.31	1.55	1.06	1.40
Live lambs born per ewe conceived	1.25	1.54	1.06	1.38
Live lambs born per ewe available for breeding	0.91	1.11	0.75	1.00

Thus *FecB* homozygous and heterozygous ewes produced 21% and 48% more live lambs per ewe available for breeding than non-carrier ewes. The performance of heterozygous ewes was better than that of homozygous ewes as they had a smaller proportion of stillbirths. We intend to reduce the incidence of stillbirths by employing selection against poor reproductive performance and by improving the ewes' nutrition in late pregnancy.



All ewes are bred by AI in order to use a large number of breeding rams and maintain accurate pedigree records. Each AI programme in 2013-14 went on for one month, roughly covering two oestrus cycles. Ewes were inseminated in natural oestrus detected by vasectomized teaser rams. All ewes were inseminated cervically once, about 12 hours after oestrus detection. Ewes were inseminated with fresh, diluted semen of the allotted rams. The high conception rate achieved (82 to 86%) proves the high standard of practices used for the AI programme. Adequate numbers of unrelated breeding rams were used to keep inbreeding under control. Genetic analysis was used to

estimate breeding values.

During 2013-14, we sold 36 breeding rams (24  $FecB^{BB}$  and 12  $FecB^{B+}$ ) and 31 young breeding ewes (9  $FecB^{BB}$  and 22  $FecB^{B+}$ ). Out of these, 18  $FecB^{BB}$  breeding rams were purchased by the Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar for their sheep project under the Rashtriya Krishi Vikas Yojana, being implemented by the Bangalore Veterinary College.

#### B. Genotyping of sheep DNA for the *FecB* locus :

**Table 2. FecB genotypes of sheep belonging to NARI tested at the AHD laboratory during 2013-14**

Breed	Number of animals genotyped	<i>FecB<sup>BB</sup></i>	<i>FecB<sup>B+</sup></i>	<i>FecB<sup>++</sup></i>
Garole and crosses	21	13	8	0
Crossbred NARI Suwarna lambs	297	88	163	46
Confirmation of genotypes initially determined on pedigree	21	6	15	0
Re-genotyping of parent on obtaining doubtful genotype of the progeny*	3	0	3	0
<b>Total</b>	<b>342</b>	<b>107</b>	<b>189</b>	<b>46</b>

\* The three parents' FecB genotypes were found to have been incorrect.

*FecB* genotyping of 236 sheep blood samples received from Prof. Abdullah Alowaimer, King Saud University, Saudi Arabia was done in the Molecular Genetics Laboratory of AHD in June 2013 and January 2014. Of the 236 samples, 88 were heterozygous carriers and 148 were non-carriers. The results and gel photographs were sent to him.

## **Project II. Osmanabadi Goat Field Unit**

**Funding agency :** Indian Council of Agricultural Research (ICAR), Government of India, New Delhi

**Scientists :** Dr. Chanda Nimbkar, Dr. Pradip Ghalsasi

**Technical staff :** Mr. Kanhaiya Chavan, Mr. Navnath Patange, Ms. Bharati Pawar, Mr. Haribhau Thombare (in Kamone, Dist. Solapur), Mr. Sachin Kakade, Ms. Surekha Murumkar (in Sakat, Dist. Ahmednagar), Ms. Archana Nimbalkar (from 16/9/2013), Mr. Sushant Choramale (from 4/1/2014), Mr. Shahaji Kakade (from 1/9/2013 in Borla, Dist. Ahmednagar), Ms. Sanjana Khomane (up to 31/1/2014)



A new centre of the Osmanabadi Field Unit was started in July 2013 in Borla village (with about 130 goats) in Jamkhed taluka of Ahmednagar district, thus making the total number of centres four; Wadgaon in Satara district, Kamone in Solapur district and Sakat and Borla in Ahmednagar district. Total 723 adult does and their 1505 kids were recorded during

2013-14. There were 116, 297 and 310 adult female goats in Satara, Solapur and Ahmednagar districts respectively, belonging to 232 goat keepers. The average number of goats per household was thus 3.12. All goats and kids were protected with vaccination as per schedule and deworming and spraying as required. Milk yields of 400 does were recorded about four times during the lactation. The opening and closing balances of the number of recorded goats classified according to sex and age group are given in Table 3.

About 90% of the does older than one year, kidded during the year and 15-20% of the does kidded twice in the year. The average litter size from 874 kiddings during the year in the four villages was 1.72. 51% of the kidded does had twins, 39% had singles and 10% had triplets or quadruplets. The overall average litter size over five years was 1.68 from 5,662 kids born in 3,372 kiddings.

**Table 3. Flock statistics of Osmanabadi goats at four centres (2013-14)**

<b>Age and sex</b>	<b>Opening balance (1-4-2013)</b>	<b>Closing balance (31-3-2014)</b>
<b>Males :</b>		
0 - 3 M	196	135
3 - 6 M	157	214
6 – 12 M	52	103
> 12 M (Adult)	15	25
Total	<b>420</b>	<b>477</b>
<b>Females</b>		
0 - 3 M	173	130
3 - 6 M	166	261
6 - 12 M	125	121
>12 M (Adult)	644	723
Total	<b>1108</b>	<b>1235</b>
G. Total	<b>1528</b>	<b>1712</b>

**M = Months**

### **Body weight**



The least squares means of birth, 3, 6 and 9 month weights of kids from project villages in Satara, Osmanabad, Solapur and Ahmednagar districts are given in Table 4. There were 2,286 birth weight records, 1,555 three-month weight records, 306 six-month weight records and 103 nine-month weight records. Weight records at the age of six months or more are few as 35% male kids (compared to 49% in 2012-13) and 21% female kids (compared to 25% in 2012-13) of the age of 3-6 months were sold in total from all villages. Out of the remaining kids, 63% males (compared to 73% in 2012-13) and 40% females (compared to 41% in 2012-13) were sold at the age of 6-12 months. The overall least squares mean weight was  $2.4 \pm 0.07$  kg at birth,  $10.5 \pm 0.2$  kg at three-months,  $15.7 \pm 0.6$  kg at 6-months, and  $22.7 \pm 1.9$  kg at nine months. The phenotypic standard deviation of 3-month weights was 2.7 kg and that of 6 month weights was 3.8 kg, indicating substantial scope for selection. The highest weight at three months was 20.0 kg while the highest weight at six months was 30.8 kg.

The average growth rate up to three months of single, twin and triplet kids was 102 g, 82 g and 75 g per day respectively. It was about 54 g per day, 61 g per day and 53 g per day for single, twin and triplet born kids from three to six months of age. The average kid growth rates differed among villages. The average daily gain of kids up to three months age was higher in Karmala and Jamkhed talukas (89 g) than in Phaltan taluka (73 g).

**Table 4. Least squares means of body weight (kg) of Osmanabadi kids (2013-14)**

<b>Factor</b>	<b>Birth weight (kg) Up to 4 days from birth</b>		<b>Weight at 3 months (kg)</b>		<b>Weight at 6 months (kg)</b>		<b>Weight at 9 months (kg)</b>	
	No.	LSM $\pm$ s.e.	No.	LSM $\pm$ s.e.	No.	LSM $\pm$ s.e.	No.	LSM $\pm$ s.e.
<b>Overall mean</b>	2286	2.4 $\pm$ 0.07	1555	10.5 $\pm$ 0.2	306	15.7 $\pm$ 0.6	103	22.7 $\pm$ 1.9
<b>Type of birth</b>								
Single	511	2.8 $\pm$ 0.02	363	12.0 $\pm$ 0.1	75	16.9 $\pm$ 0.5	34	23.3 $\pm$ 1.1
Twin	1389	2.6 $\pm$ 0.02	988	10.0 $\pm$ 0.1	179	15.5 $\pm$ 0.4	53	21.9 $\pm$ 1.0
Triplet	365	2.2 $\pm$ 0.03	198	9.0 $\pm$ 0.2	48	15.0 $\pm$ 0.8	16	22.1 $\pm$ 1.7
Quadruplet	20	1.9 $\pm$ 0.13	6	8.1 $\pm$ 1.4	4	14.4 $\pm$ 3.4	-	-
<b>Sex</b>								
Male	1186	2.5 $\pm$ 0.04	815	10.5 $\pm$ 0.4	131	16.6 $\pm$ 0.9	43	24.0 $\pm$ 1.2
Female	1100	2.3 $\pm$ 0.04	740	9.0 $\pm$ 0.4	175	14.3 $\pm$ 0.9	60	20.9 $\pm$ 1.0

### Milk production

The least squares means of 100 day milk yield for different levels of significant fixed effects are given in Table 5. The 100-day milk yield of does that had given birth to single, twin, triplet and quadruplet kids was 63.6 $\pm$ 2.1 kg, 94.4 $\pm$ 1.8 kg, 126.8 $\pm$ 3.8 kg and 144.7 $\pm$ 14.9 kg although there were only four records of does with quadruplets. There was about a 50% increase in milk yield with the increase in litter size from single to twins and a 34% increase when the litter size increased from twins to triplets. Goats from Kamone in Karmala taluka had 34% higher least-squares mean 100-day milk yield than those in Phaltan taluka. We have been able to identify good milk producing does in the villages. Out of 887 does whose 100-day lactation milk yields were analyzed, 18 does (2%) were found to yield more than 200 litres and one doe had a 100-day lactation yield of 330 litres.

**Table 5. Least squares means of 100-day milk yield of Osmanabadi does (2013-14)**

<b>Litter size of the doe</b>	<b>Number of observations</b>	<b>LSM±SE (kg)</b>
1	313	63.6 ± 2.1
2	495	94.4 ± 1.8
3	75	126.8 ± 3.8
4	4	144.7 ± 14.9
<b>Parity</b>	<b>Number of observations</b>	<b>LSM± SE (kg)</b>
1	93	100.5 ± 5.0
2, 3 and 4	271	110.9 ± 4.3
5, 6 and 7	279	109.1 ± 4.2
≥ 8	244	109.1 ± 4.1
<b>Taluka</b>	<b>Number of observations</b>	<b>LSM ± SE (kg)</b>
Phaltan	334	96.3 ± 4.4
Kalamb	85	97.3 ± 5.2
Karmala	384	129.1 ± 4.4
Jamkhed	84	106.9 ± 5.0

## **Reproductive performance**

### **Age at first kidding**

The age at first kidding of 201 does born from 2009 to 2012 was available accurately. The average age at first kidding was 413±90 days (about 13.5 to 14 months) with a range of 249 to 703 days. This means that the average age at first ovulatory oestrus is 8.5 to 9 months.

### **Kidding interval**

The average kidding interval was 282.7±83.4 days or 9.4 months.

### **Osmanabadi buck semen freezing**

We have frozen about 7000 semen doses of 25 Osmanabadi bucks in straws in the ‘State of the Art Buck Semen Freezing and AI Centre’ set up at NARI with a grant from the Government of India under the ‘Integrated Development of Small Ruminants Scheme’. Of these 4000 were given to the Government of Maharashtra and were supplied by the government to five district AI centres – Solapur, Ahmednagar, Aurangabad, Buldhana and Osmanabad. Seven hundred straws were given to field technicians in Satara, Solapur,

Ahmednagar, Pune and Nashik districts and 100 straws were taken by veterinarians in Bangalore district in Karnataka. Five hundred doses have been deposited at the semen bank at NBAGR for breed conservation, as per the technical programme of the AICRP on Goat Improvement. Each dose contains 100 million spermatozoa and the post-thaw progressive motility of the frozen semen is > 60%. The conception rate using frozen semen on cervical AI of does in natural oestrus at the goat keepers' door or brought to our farm was 50% on average. The Unit has thus refined, validated and implemented AI in the field. We have more than 1000 frozen semen doses of Osmanabadi bucks in storage.

## **Socio-economic survey**

Goat keeping was a supplementary occupation to crop farming for the majority of the goat keepers under the project. Up to 90% of goat keepers from all project villages owned some land. About half the goat keepers from all project villages were young (in the 31-50 years age group), but one third to half the goat keepers in each centre were illiterate.

Forty to 50% of the goat keepers in all the villages kept only one adult doe each while another 34 to 47% kept two to five adult does each. About half the does in the project were with families owning less than 5 does each while half were with families owning 6-20 does.

The main source of income from Osmanabadi goat rearing is sale of kids below one year of age. During 2013-14, 35% of the 879 male kids and 21% of the 902 female kids in the 3-6 months age group were sold while 63% of the 392 male kids and 40% of the 586 female kids in the 6-12 months age group were sold by project goat keepers.

The average kidding interval was 9.4 months, implying each goat had 1.3 kiddings per year. With the average litter size of 1.72 kids, this means 2.24 kids born per doe per year. With an average 6% mortality in the 0 to 6 months age group, this means 2.1 saleable kids per doe per year. For an average sale weight of 14 kg and average sale price of Rs.180 per kg, this works out to a gross income of Rs. 5,292 per doe per year.

## **Dissemination of pro-poor goat-based technologies**

For the first time in 2013-14, fodder seed of the legume *Desmanthus virgatus* and of the multi-cut fodder sorghum variety COFS-29 developed by the Tamil Nadu Agricultural University was supplied to 16 participating goat keepers in Wadgaon and Kamone. They have developed small fodder plots using the seed and their goats have benefited from good quality home-grown fodder.

Four self-help groups (SHG) of women (61 members in total) were established in Wadgaon, Borla and Kamone. These are operating smoothly with regular meetings and micro-finance benefits to all members. The women SHG members of Wadgaon were trained in goat management and first-aid in evening one-hour sessions held in their village in the first week of January 2014 and three of the women can now do preliminary treatment of their goats. The training course started with nine trainees out of which five were enthusiastic and attended every session. They were given diaries and important points and hints from the training content were written in them. The topics covered in the training were :

- Importance of weighing kids
- How to estimate the expected sale price of a kid or goat

- How to estimate age of a goat from dentition
- How to select a goat for purchase
- Control of ecto-parasites such as ticks and fleas
- Importance of vaccination of goats and the three important goat vaccines ET, HS and PPR
- Sustainable worm control in goats, use of the FAMACHA chart to detect anaemia due to *Haemonchus contortus* infection in goats
- Goat management at the time of kidding and feeding management of young and growing kids
- Types of wounds and methods of dressing and treating them
- How to detect sickness in goats and simple oral medicines for ailments of the respiratory and digestive systems

**Project III. Setting up a State of the Art A.I. Centre for sheep and goats under the Central Sector Scheme ‘Integrated Development of Small Ruminants and Rabbits’.**

**Funding agency :** Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Government of India, New Delhi.

**Scientist :** Dr. Pradip Ghalsasi, Dr. Chanda Nimbkar

**Technical Staff :** Mr. Kanhaiya Chavan, Mr. Rupsing Khanvilkar, Ms. Padmaja Ghalsasi, Ms. Sonali Sawant, Mr. Dattatray Mulik

**Total amount :** Rs.199.73 lakh

**Date of sanction :** 24 November 2010

NARI submitted the Utilization Certificate for the third and fourth installments of total Rs.50 lakhs to the District Deputy Commissioner, Animal Husbandry, Government of Maharashtra, Satara to be forwarded to the Secretary, Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, New Delhi on 28 March 2014. This amount was used to purchase Air wash showers, Electronic pass boxes, Air wash curtains and 20 Osmanabadi and 5 Boer bucks. Most of the amount is spent on construction of a new custom-built semen freezing laboratory. The construction work is in progress.

### **Developments**

- Initially supplied 600 frozen semen straws to 12 private livestock supervisors in three districts in Maharashtra for a free trial. They reported a 50% conception rate on kids born basis (Table 6).
- 500 frozen semen straws of Osmanabadi bucks were given for conservation to the National Bureau of Animal Genetic Resources (NBAGR), Karnal, Haryana as per the technical program of the All India Coordinated Research Project on Goat Improvement of ICAR-Osmanabadi field unit at Nimbkar Agricultural Research Institute.
- 4000 Osmanabadi and 1000 Boer buck frozen semen straws were supplied to the Animal Husbandry Department of Government of Maharashtra. These were further supplied by the government to district AI centres in Ahmednagar, Aurangabad, Buldhana, Osmanabad and Solapur districts.
- 176 goats belonging to farmers from villages surrounding Phaltan and 166 goats of the Institute were artificially inseminated during 2012-14 using these frozen semen straws. The overall conception rate achieved was 55%.

- Semen freezing has been carried out in NARI's A.I. Centre using 22 Osmanabadi bucks belonging to the Osmanabadi goat field unit under the All India Coordinated Research Project on Goat Improvement at NARI, 6 Boer bucks belonging to the Maharashtra Goat and Sheep Research and Development Institute, 12 Boer bucks belonging to Nimbkar Seeds Private Limited and 4 Alpine and Saanen X Beetal crossbred bucks purchased by NARI from the National Dairy Research Institute, Karnal (Table 7).

**Table 6. Results of cervical AI of does carried out with frozen buck semen on NARI farms and in the field**

Location	Period	No. of goats inseminated	No. goats monitored	No. of goats conceived	Conception rate
NARI farms	June 2012-November 2013	173	155	87	56%
Four field AI technicians	August 2012-June 2013	157	145	71	49%

**Table 7. Production and utilization of buck frozen semen doses during the period 9 January 2012 to 31 March 2014**

Particulars	Number of semen straws					Total
	Boer bucks	Osmanabadi bucks	Damascus cross bucks	Alpine X Beetal bucks	Saanen X Beetal bucks	
Frozen	5594	7061	732	838	102	14327
Discarded doses	401	310	0	0	0	711
Sold	3336	4731	327	220	10	8624
Given free for trial	538	330	0	0	0	868
Used for AI of farmers' goats	90	78	2	5	1	176
Used for AI of NARI farms' goats	161	1	4	0	0	166
Used for demo	52	3	48	0	0	103
NBAGR	0	500	0	0	0	500
Used for NSPL farm goats	55	0	20	0	0	75
In storage	961	1108	331	613	91	3104

#### **Project IV. Vegetative propagation of NARI Nirbeeja KX2 Hybrid Leucaena (Subabhal)**

##### **Funded Internally**

**Scientists :** Mr. B.V. Nimbkar, Dr. Nandini Nimbkar, Dr. Chanda Nimbkar

**Technical staff :** Ms. Padmaja Ghalsasi, Ms. Sonali Sawant



The AHD, NARI is a pioneer in India in successfully propagating KX2 which is an outstanding hybrid of *Leucaena leucocephala* X *Leucaena pallida*. KX2 provides high quality fodder for ruminants with >35% dry matter and 25-30% crude protein. This can replace expensive commercial concentrate feed to a large extent. AHD has named the cross ‘NARI Nirbeeja’. This accession is highly resistant to the psyllid, an aphid-like pest which attacks and destroys Subabhal leaves for three or more months in winter. KX2 is fast growing and produces very little or no seed and the seed

is usually not fertile, hence the name *Nirbeeja*. The propagation of KX2 therefore needs to be vegetative.

The protocol for rooting of cuttings of the psyllid-resistant, high yielding and protein rich fodder tree hybrid *Leucaena* KX2 or NARI *Nirbeeja* has been refined at NARI and now success rates of 50% are achieved routinely. The rooting is carried out in a shade-net house where high humidity chambers of polythene tunnels are erected. 30-45 days old, 15 cm long cuttings of KX2, treated with fungicide and dipped in rooting hormones, are inserted into cocopeat in plastic cups in trays. The optimum humidity and temperature required for the cuttings is maintained in the tunnels manually by adjusting these according to the climate. During the rooting process, the cuttings and the medium are treated periodically with fungicide. The root system develops in about 4-5 weeks, after which, the plants are transplanted into plastic bags filled with soil which are kept in a hardening chamber. The humidity in the hardening chamber is reduced gradually over two weeks. The plants are then kept in the shade net house for another two weeks for further hardening before planting them out into soil.

##### **Findings**

The average rooting percentage obtained during the year was 40-55%. Cuttings taken from hardened plants kept in the shade net house had a rooting success rate of 80-85%. This is because the cuttings used were from the same environment, not from outdoors, were juvenile, having maximum vigour and were themselves rooted cuttings, which means they possessed the rooting capacity. 345 KX2 plants were produced during the year, at a cost of Rs.150 per plant. Our endeavour is to reduce the cost.

#### **Project V. Comparison of wet biomass yield from psyllid-resistant KX2 hybrid Leucaena trees developed using three different methods – rooting of cuttings, grafting on to rootstock of K8 seedlings and growing from seed**

##### **Funded Internally**

**Scientists :** Mr. B.V. Nimbkar, Dr. Nandini Nimbkar, Dr. Chanda Nimbkar

**Technical staff :** Ms. Padmaja Ghalsasi, Ms. Sonali Sawant

### Propagation methods

- 1. Rooting of cuttings :** The rooting of bi-nodal cuttings of KX2 was done in high humidity chambers of polythene sheets over sand beds which measured about 1.8 m X 0.9 m. Rooting hormones 1% Indole Butyric Acid (IBA) and 0.5% Naphthalene Acetic Acid (NAA) were used. Bi-nodal juvenile cuttings about 10 cm in length and 5–7 mm thick in diameter were dipped in IBA and NAA and inserted about 2 cm deep in the sand beds. Water was sprayed about four times a day to maintain 70-75% humidity and 30-32°C temperature. After about 4-5 weeks the cuttings rooted and were transplanted to nursery bags containing a soil mixture. The plants were kept in a separate humidity chamber where moisture percentage was decreased gradually every week so that hardening of the plants commenced. After about two weeks the acclimatization process was complete and the plants were moved to a shade net house for further hardening before transplanting out in the field.
- 2. Grafting :** Wedge grafting was done using scions of KX2 (*Nirbeeja*) and rootstock of *Leucaena leucocephala* which is one of the parents. A perpendicular slit was made on the rootstock. A bi-nodal scion having the same length as the slit was fitted exactly in the slit. The scion and rootstock were then tightly tied together using stretchable plastic ribbons. Care was taken to protect the graft area from contact with air or water. The grafts were individually covered with plastic bags to protect the scion from drying out and increase the humidity to promote new shoots. After grafting, the scions sprouted within a week and the new shoots started to grow. It took about 3-4 weeks for complete joining of the rootstock with the scion. After about three weeks the grafts were hardened for two weeks and were then transplanted into soil.
- 3. Seedlings :** A packet of 95 KX2 sample seeds was obtained from ECHO seed bank, Florida, USA. The seeds were planted in the nursery of AHD in September 2011. The emergence of the seedlings was slower (taking more than eight days) than the four days taken by normal local *Leucaena* and the germination was 52%. The vigour of these plants was also found to be low and they grew at a slow pace.

### Measurements

There were 15-16 plants in each row and one row each of rooted, grafted and seeded trees was chosen for measurement. The trees were cut every 12 weeks at a height of 1 m from the ground. The wet edible biomass from each tree was weighed. The least squares means of weights reported in Table 8 are from five harvests carried out from December 2012 to November 2013.

**Table 8. Least squares means of wet biomass (kg) per harvest of KX2 trees propagated by different methods (records from five cuttings)**

Tree propagation method	Number of trees	Number of records	Wet edible biomass (kg) per tree
Rooted cuttings	15	72*	2.71 ± 0.12
Grafting	16	77*	1.29 ± 0.12
Seed	16	80	0.85 ± 0.11

\* One tree developed from a rooted cutting and one grafted tree died due to gummosis (caused by *Fusarium semitectum*) so their records for only two harvests are available.

**Conclusion :** The wet biomass yield from rooted cuttings of KX2 (*Nirbeeja*) was 110% higher than that from grafted KX2 trees and 219% higher than that of trees developed. Rooting of cuttings is therefore the best method of propagation of KX2 (*Nirbeeja*) from seeds.

#### **Project VI. Research in veterinary parasitology with special reference to sheep and goats.**

##### **Funded Internally**

**Scientists :** Dr. Pradip Ghalsasi, Dr. Chanda Nimbkar

**Technical staff :** Ms. Padmaja Ghalsasi, Ms. Sonali Sawant, Mr. Kanhaiya Chavan, Mr. Rupsing Khanvilkar, Mr. Dattatraya Mulik, Mr. Dilip Bhandare, Mr. Anil Chavan



During 2013-14, the gastrointestinal (GI) worm burdens due to natural infection in NARI's sheep and goats and in goat keepers' goats participating in NARI's projects were monitored and animals were dewormed either *en masse* or individually considering the severity of the worm burden. Since September 2012, we have been using the FAMACHA<sup>®</sup> chart (developed by the South African scientists) as a guide to decisions on which animals to deworm. The chart is an anaemia guide to identify those sheep and goats which cannot cope with infection by the blood-sucking worm *Haemonchus contortus*. The anaemia caused by the infection can be detected from the colour

of the inner eye mucous membrane (conjunctiva) of the animal. This colour is matched with the colour in one of the five categories presented in the FAMACHA<sup>®</sup> chart. The animals which correspond to categories 3, 4 and 5 are considered anaemic and treated with anthelmintic while animals in category 1 and 2 do not show the adverse effects of worm infection and hence do not need anthelmintic treatment. Use of the chart thus helps to minimize the use of anthelmintics with a view to reduce the chances of development of anthelmintic resistance in worms. This system also helps to maintain a population of untreated larvae (refugia) on the pasture in order to delay the development of anthelmintic resistance in worms.

We also measured the faecal worm egg counts (FEC) of the animals and the animals which had a count of >2,000 eggs per gram of faeces (epg) were also treated with an anthelmintic even if they had a lower FAMACHA<sup>®</sup> score. This was done in order to control pasture contamination.

## Observations

- *Haemonchus contortus* is a predominant (70 to 90%) worm species in and around Phaltan region so the FAMACHA<sup>®</sup> system can be applied usefully.
- We found that animals with FAMACHA<sup>®</sup> scores  $\geq 3$  also had high FEC.
- During the year, as the rainfall was comparatively higher than the previous year, worm infections and consequently worm burdens on pasture were higher. Therefore, the long acting anthelmintic Closantel was administered to all grazing animals at NARI. It protected the animals from reinfection for at least 30 days and FEC did not build up for at least 55 days post drench.
- At **Wadjal farm** during the year complete flock monitoring for FEC was done four times. The FAMACHA<sup>®</sup> scores of all the sheep and goats were recorded. The majority of the animals were in categories 1 and 2 indicating they were not anaemic. Some animals which scored 3 were effectively dewormed using the broad spectrum anthelmintic Ivermectin or Injectable Levamisole. The animals which were transferred from one farm to another were checked for worm infection before mixing them with animals already on the farm. Breeding rams transferred to Wadjal from Lundy farm and Dhuldeo farm were all drenched as they had high FEC. Their mean FEC was 1139 epg and the range was 100 to 3400 epg. Some crossbred lambs, Awassi and Garole lambs and goat kids were found to have tapeworm infection. These were treated with Fentas plus which contains Praziquintel that removes the parasite completely.
- Some bucks, goats and kids at Wadjal and Dhuldeo farms were found to have FAMACHA<sup>®</sup> scores of 3 but they had very low FEC. They were instead found to be infested with the ecto-parasites fleas and ticks. They were effectively sprayed with either chemical or herbal remedies such as Neem and Karanj oil mixed with soap solution in recommended proportions. The housing and floors were burnt on the surface with a flame gun. The goats were given iron injections to compensate for the loss of blood due to ecto-parasites.
- At **Dhuledo farm**, the FEC and FAMACHA<sup>®</sup> scores of all goats and sheep were measured four times during the year. The goats were individually drenched twice and mass drenched twice. Goats cannot tolerate worm infections to the extent that sheep do. Although the goats were mass drenched with short acting Ivermectin in September and were stall-fed to avoid reinfection, they were again found to be infected in October when their FEC were measured. They were then given long acting Closantel treatment. The maiden and adult ewes were mass dewormed once and individual treatment of infected animals was done three times.
- At **Lundy farm** complete flocks of pregnant, lambed, empty ewes and lambs were measured for FEC and FAMACHA<sup>®</sup> three times. Two groups of lambed ewes were mass dewormed at different times. Pregnant and empty ewes and weaned lambs were mass drenched twice. Individual treatment of inseminated ewes was done once in September using long acting anthelmintic. Out of the 145 ewes measured, only 50 ewes needed treatment. Out of these, 27 had FAMACHA<sup>®</sup> scores  $>3$  and 23 had FEC  $>2000$  epg but low FAMACHA<sup>®</sup> scores. These were treated to avoid pasture contamination. Later in January, this group was mass dewormed with Albendazole and then moved to Dhuldeo farm. All the lambs aged 4-5 months were screened and 33% were found to be affected by Tapeworm infection which was effectively treated using the Fentas plus. Protozoal infection such as coccidiosis was not observed in any of the flocks during the reporting period.

## Findings

- The faecal egg count rise was observed in all the parturient ewes or does and also those close to lambing or kidding including some Garole ewes and kidded does. The rise is seen due to hormonal effect which lowers the immunity and also due to the severe stress of lambing/kidding. The Garole ewes showed a lower rise in FEC compared to the rise in crossbred ewes. For example, the maximum FEC seen in a lambed Garole ewe in April was 2000 epg, while in a crossbred ewe lambred in May, it was 5600 epg. The crossbred ewes were mass treated with anthelmintic while only a few Garole ewes were treated.
- Generally 20 to 30% of the animals in every flock have high worm egg counts which contaminate the pasture. During the year, not all the animals in our grazing flocks needed to be treated with anthelmintic. Some examples are given in Table 9.

**Table 9. Proportions of animals with heavy worm infections in different flocks and proportions dewormed**

Farms and Animals	Date of FEC	Numbers sampled from the total flock	Number of animals with FEC 2000 to 5000 epg	Number of animals with FEC >5000 epg	Proportion of total animals with high FEC (%)	Proportion of animals drenched* (%)
Wadjal Breeding rams	27/4/13	40/41	6	0	15	40
	24/7/13	21/21	8	0	38	50
Dhuldeo Goats	2/5/13	44/45	8	0	18	36
	28/6/13	56/56	11	1	22	22
Lundy Breeding ewes	5/9/13	58/152	5	3	14	33
	13/9/13	94/152	22	16	40	

\*Criteria for drenching – FAMACHA score  $\geq 3$  and/or FEC  $\geq 2000$  epg

**Project on enhancement of milk-giving capacity of non-descript goats in Mann taluka by genetic improvement to be achieved by cross-breeding with dairy breeds.**

**Collaborator :** Mann Deshi Foundation (MDF), Mhaswad

**Funding :** Donations from Mr. Uday Gujar to MDF and donations from Mr. B. V. Nimbkar and Smt. Jai Nimbkar to NARI

Personnel from MDF - Smt. Vanita Shinde, Smt. Sunita Tarlekar, Smt. Surekha Kalel, Smt. Chetna Sinha

Personnel from NARI – Shri. B. V. Nimbkar, Dr. Nandini Nimbkar, Dr. Chanda Nimbkar Dr. Pradip Ghalsasi, Shri. Kanhaiya Chavan

Mann is a small taluka located to the east of Phaltan. It is a perpetually drought-prone and highly eroded region. Mann taluka has a large population of around 80,000 goats and 90,000 sheep. Shri. B. V. Nimbkar felt that this region would tremendously benefit if goats could be improved by introducing genes into them to increase their milk production. Therefore, in early May 2013 he approached Smt. Chetna Sinha - the president of MDF, an NGO working in this region. After getting her consent an MOU between MDF and NARI was signed in July 2013. NARI AHD has expertise in freezing of goat semen and doing artificial insemination (A.I.) in goats, so in September 2013 we trained three village women for doing A.I. in goats. From the first week of October one of these women – Smt. Surekha Kalel from the village Jambhulani was employed to work in two villages – Jambhulani and Pulkoti, with a total population of about 1500 goats. Initially Smt. Kalel collected the data of about 500 goats. Though the breeding seasons of goats is generally from April to October, as a trial we synchronized 50 goats using hormones in December and on January 1, 2014 inseminated them with four types of semen – (1) The South African Boer (2) The local Osmanabadi (3) The Beetal – Alpine cross and (4) The Syrian Damascus. Only eight of the goats became pregnant and are expected to deliver in June 2014.

We hope to show by next year that increasing milk yield of the mothers will result in better growth of their kids if provided milk for 60 days and after that the milk could be used for family consumption to provide much needed protein.

## **I. PUBLICATIONS** **(In Alphabetical Order)**

### **Refereed publications**

1. Nimbkar, C. 2013. Sustainable improvement in sheep productivity in India using the FecB (Booroola) mutation. Chapter 3.1. In Biotechnologies at work for smallholders: Case studies from developing countries in crops, livestock and fish. Occasional papers on innovation in family farming. Food and Agriculture Organisation of the United Nations. pp. 72-81.
2. Nimbkar, C., Kataria, R. S., Mishra, B. P., Joshi, B. K. and Ghalsasi, P. M. 2013. The *FecB* mutation increases lamb production in smallholder subsistence flocks in Maharashtra state of India. Proceedings of the 20<sup>th</sup> Conference of the Association for the Advancement of Animal Breeding and Genetics (AAABG) held at Napier, New Zealand on 20-23 October 2013. pp. 167-170.
3. Nimbkar C. 2014. Breeding strategies for genetic improvement of goats and sheep in India. In 'Abstracts and Souvenir of the National Seminar and annual conference of the Indian Society of Sheep and Goat Production and Utilization on 'Sheep and goat Biodiversity and breeding policies - issues and perspective' organised by Krantisinh Nana Patil College of Veterinary Science, Shirwal, at Mahabaleshwar, Maharashtra on 21-22 February 2014. pp. 45-52.
4. Rajvanshi, A. K. 2013. [Kerosene revisited – excellent fuel for rural households.](#) Current Science. Vol. 105 (4) : 435-436.
5. Singh, V., Bhagwat, V., Kolekar, N., Siddique, A. and Nimbkar, N. 2014. Diallel analysis of sugar and sugar contributing characters in sweet sorghum [*Sorghum bicolor* (L.) Moench]. J. Agric. Res. Technol., 39 : 50-55.
6. Singh, V., Kolekar, N. M. and Nimbkar, N. 2013. Maximization of flower yield in safflower (*Carthamus tinctorius* L.). J. Oilseeds Res. 30 : 43-47.

### **Non-refereed publications**

Ghalsasi, P. P., Ghalsasi, P. M. and Nimbkar, C. 2014. Assessment of the FAMACHA<sup>©</sup> anaemia guide card in sheep and goats in Maharashtra. In compendium of XXIV National Congress of Veterinary Parasitology and National Symposium on 'Towards Food Security through Sustainable Animal Production and Integrated Parasite Management' held at College of Veterinary and Animal Sciences, Mannuthy, Kerala. p. 81.

### **Project proposals**

Nimbkar, C., Hegde, N. G., Naqvi, S. M. K. and Singh, S. K. 2013. Comprehensive Project for the Development of Small Ruminants in the Country. submitted to the Joint Secretary, Government of India, Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, New Delhi on 29 September 2013.

Dr. Chanda Nimbkar was appointed to be a member of the **Expert Committee constituted** on 10 April 2013 by the **Department of Animal Husbandry, Dairying and Fisheries,**

Ministry of Agriculture, **Government of India** to develop a **nationwide programme on promotion of accelerated production of sheep and goats**. She was nominated on 15 May 2013 also as a member of the Project Drafting Sub-committee with the responsibility for synthesis, coordination and preparation of the draft project document.

### **Popular articles in Marathi**

1. Deshpande, M. B. 2013. Safflower : A commercial crop (kardai : Vyapari Peek). Krishi Panan Mitra (October). P. 26-29.
2. Deshpande, M. B. and Singh, V. 2013. Business of safflower flowers (kardaichya fulancha vyavasay). Baliraja (September). P. 15-19.
3. Nimbkar, C. 2013. Goat rearing-supplementary activity to rainfed farming. Pure Osmanabadi goats in Dyandeo Shinde's flock. (jirayatila sath shelipalanachi, Shinde yanchya wadgyat jatiwant Osmanabadi). Agrown. 11 November 2013. pp. 8-9.
4. Nimbkar C. 2013. Financial stability achieved because of Osmanabadi goat rearing – benefits of goat improvement project (Osmanabadi sheline dile arthik sthairy – sheli sudhar prakalpache yash). Agrown. 15 May 2013. p. 9.
5. Rajvanshi, A. K. 2013. New generation will arise from self-reliant education (Swayatt shikshanatoon umlel navi pidhi) Sakal. 23 August 2013. p. 7.
6. Rajvanshi, A. K. 2014. Second green revolution through precision agriculture (katekor shetimadhoonach dusri haritkranti) Agrown. 4 February 2014. p. 7.

### **Syndicated articles**

1. Anil K. Rajvanshi, "[Nipped in bud – crisis in children's education](#)", 31 July 2013.
2. Anil K. Rajvanshi, "[Second green revolution through precision agriculture](#)", 15 October 2013.

### **Articles on NARI Website**

1. "[A simple method of measuring soot](#)", September 2013.
2. "[A short history of biomass gasification at NARI](#)", January 2014.
3. "[A short history of Household Energy R&D at NARI](#)", March 2014.

### **News**

- A meeting of goat farmers from all over Maharashtra was held at village Kavathe, Tal Wai, Maharashtra. The decision was taken to establish a goat and sheep producer association. (sheli-mendhi utpadak sangh sthapanecha nirdhar, kavathet rajyabharatil shelipalak vyavasaik shetkaryanchi baithak). Sakal. 11 September 2013 and Agrown 15 September 2013.
- Premium variety Boer goats are sold online for up to Rs.90,000. Economic Times. 21 October 2013.

- News item about the visit of the Secretary of the Department of Animal Husbandry, Dairy and Fisheries (DADF), Government of India, to the Animal Husbandry Division of NARI.
  - a. Dainik Sthairya. 3 January 2014. p. 3.
  - b. Dainik Aikya. 3 January 2014
  - c. Dainik Sakal. 9 January 2014
- Bringing awareness in cattle rearers will promote artificial insemination. (pashu palakanchya prabodhanatun vadhel krutrim retan.) Letter by Chanda Nimbkar published in ‘Readers’ correspondence’, Agrowon. 7 February 2014. p. 7.

### **Newspaper articles**

1. Anil K. Rajvanshi, “Light on dark matter and energy”, Published as Op-Ed article, Times of India, 17 April 2013.
2. Anil K. Rajvanshi, “Hair as antennas”, Published as an article in Speaking Tree, 25 June 2013.
3. Anil K. Rajvanshi, “Meditation may help alzheimer disease” Published as an article in Speaking Tree, 5 July 2013.
4. Anil K. Rajvanshi, “Nature of soothsayers”, Boloji.com website, 6 July 2013.
5. Anil K. Rajvanshi, “How to do meditation”, Speaking Tree website, 13 July 2013.
6. Anil K. Rajvanshi, “Do bootscan on yourself”, Published as Op-Ed article, Times of India, 23 July 2013.
7. Anil K. Rajvanshi, “Samadhi as a solution wave”, Speaking Tree website, 8 August 2013.
8. Anil K. Rajvanshi, “Bapu was ahead of his time”, Published as Op-Ed article, Times of India, 2 October 2013.
9. Anil K. Rajvanshi, “Light at the end of tunnel”, Published as Op-Ed article, Times of India, 31 October 2013.
10. Anil K. Rajvanshi, “Science of *pranayama* and homeopathy”, Boloji.com, 6 January 2014.
11. Anil K. Rajvanshi, “It is good to maximize experience”, Published as Op-Ed article, Times of India, 7 January 2014.
12. Anil K. Rajvanshi, “Be anchored in now”, Speaking Tree website, ? March 2014.

## Reports

1. Nandeshwar, B. C. and Patil, M. April 2013. Annual Progress Report of the All India Coordinated Sorghum Improvement Project of the Indian Council of Agricultural Research for the period 1 April 2012 to 31 March 2013. Submitted to the Directorate of Sorghum Research (DSR), Hyderabad. pp. 84.
2. Nimbkar, C. July 2013. Annual Report of ‘Osmanabadi Goat Field Unit at NARI’ under the All India Coordinated Research Project (AICRP) on Goat Improvement of the Indian Council of Agricultural Research (ICAR) for the period 1 April 2012 to 31 March 2013. Submitted to the Director, Central Institute for Research on Goats, Makhdoom, U.P.
3. Rajvanshi, A. K. October 2013. Final Project Report on “Kerosene Lanstove for Rural Areas”. Submitted to the Department of Science and Technology (DST), New Delhi. 105 pp.
4. Singh, V. August 2013. Annual Progress Report of Safflower research under the All India Coordinated Research Project (AICRP) on Oilseeds of the Indian Council of Agricultural Research (ICAR) for the period 1 August 2012 to 31 July 2013. Submitted to the Directorate of Oilseeds Research (DOR), Hyderabad. 106 pp.
5. Singh, V. July 2013. Annual Progress Report of Frontline Demonstrations in Safflower. Submitted to the Directorate of Oilseeds Research (DOR), Hyderabad. 53 pp.

## Technical bulletin/leaflet

1. Technology for seed production of thermosensitive genetic male sterility-based safflower hybrid NARI-H-23. AICRP (Safflower), Nimbkar Agricultural Research Institute, Phaltan. P. 4.

## **II. INVITED TALKS/LECTURES**

1. Chanda Nimbkar gave a presentation on 3 April 2013 on “Small ruminant rearing – breed conservation and genetic improvement”, based on the report prepared by Dr. Nimbkar and Dr. P.M. Ghalsasi for the South Asia Pro Poor Livestock Policy Program (SAPLPP), to a select group at the office of the Hon. Union Agriculture Minister, Shri Sharad Pawar at Krishi Bhawan, New Delhi. Ms. Tinni Sawhney of SA-PPLPP gave the introduction.
2. Anil K. Rajvanshi, [Rural Energy Innovations](#); An Invited talk given at Global Climate and Energy Project, Stanford University/Reliance Industries Ltd. Workshop on the search for game-changing energy technologies for the developing world at Reliance Corporate Headquarters, Navi Mumbai from 15-16 May 2013. Dr. Rajvanshi was one of the ten invitees from India (which included Dr. R. A. Mashelkar and Dr. Kirit Parikh among others).
3. Anil K. Rajvanshi, “Renewable Energy R&D at NARI”, talk given to 75 Mechanical engineering students and faculty of Cummins Engineering College for Women, Pune. Bajaj Center for Sustainable Development, NARI, 1 August 2013.

4. Anil K. Rajvanshi, "[Have Junoon be Happy](#)"; A Student Gymkhana lecture given to about 250 students and faculty at IIT Bombay, 4 September 2013.
5. Anil K. Rajvanshi, "Renewable Energy for Farming"; Lecture to 35 women farmers from Andhra Pradesh, Bajaj Center for Sustainable Development, NARI, September 2013.
6. Chanda Nimbkar attended 'The Sheep Breeders' Day' programme held at Hawke's Bay A and P Showgrounds, Tomoana, North Island, New Zealand on 24 October 2013 organised by Abacus Bio Limited, New Zealand. She gave a presentation on 'Sheep rearing in India' in session I: International Perspectives on farm systems and issues facing sheep breeders and the industry in different countries.
7. Anil K. Rajvanshi, "Inspirational lecture to Odisha Board Class X and XI toppers as a part of INSPIRE program run by Department of Science and Technology (DST). Around 250-300 students attended the lecture organized by National Institute of Science and Technology (NIST), Behrampur, Odisha, 29 November 2013.
8. Anil K. Rajvanshi, "Decentralized renewable electricity generation for rural areas", Keynote lecture at AICTE-sponsored National conference entitled dispersed generation and smart grids. National Institute of Science and Technology (NIST), Behrampur, Odisha, 30 November 2013.
9. "General discussions on renewable energy for rural areas", Half day workshop for 15 IIT Bombay students at Bajaj Centre for Sustainable Development, NARI, 27 December 2013.
10. Chanda Nimbkar gave a presentation on 'Rural Veterinarians – Agents of Rural Transformation?' at the state level "Technical Symposium" organised by the Karnataka Veterinary Association at Gulbarga, Karnataka on 14 December 2013.
11. Chanda Nimbkar gave a presentation on 'Breeding Strategy for Productivity Enhancement of Small Ruminants' in the Brainstorming workshop on 'Strategy Related to Conservation and Productivity Enhancement of Farm Animal Genetic Resources' organized by the Indian Council of Agricultural Research, at the NASC complex, New Delhi on 10 January 2014.
12. Chanda Nimbkar gave a lecture on 'Advanced technologies in goat and sheep rearing' in a training program organised by the Sakal International Learning Centre, Pune on 20 February 2014.
13. Chanda Nimbkar presented a lead paper 'Breeding Strategies for genetic improvement of goats and sheep in India' at the National Seminar and annual conference of the Indian Society of Sheep and Goat Production and Utilization on 'Sheep and goat biodiversity and breeding policies-issues and perspective' organised by Krantisinh Nana Patil College of Veterinary Science, Shirwal, at Mahabaleshwar, Maharashtra on 21 February 2014.
14. Kanhaiya Chavan gave a speech on 'Improved goat and sheep development' to farmers at the Mandeshi Agriculture and Livestock Exhibition organised by Man Taluka Yashaswini Mahila Bachat Gat and Anilbhau Desai Yuva Foundation at Dahiwadi, Dist. Satara, M.S. on 24 February 2014.

15. Anil K. Rajvanshi, “NARI’s work in rural development”, Invited talk at conference entitled “Ethics, equity and inclusion in science and technology – Global and regional perspectives”. Organized by Research and Information System for developing countries (RIS). Ministry of External Affairs, GOI. Ashoka Hotel, New Delhi, 6-7, March 2014.
16. Anil K. Rajvanshi, “Junoon, Technology and Happiness”, Chief Guest lecture at inauguration of Cognizance 2014, IIT Roorkee, March 21, 2014.

### **III. CONFERENCES/SEMINARS/MEETINGS/WORKSHOPS ATTENDED BY STAFF (In Chronological Order)**

1. Dr. Chanda Nimbkar attended the inaugural function of a demonstration cum training programme on ‘Development of woolen handicrafts’ held at TMT Division of CSWRI, Avikanagar, Rajasthan on 1 April 2013. She was the chief guest of the inaugural function and addressed the participants.
2. Dr. Chanda Nimbkar addressed the participants of a short-term training program on ‘PCR based genotyping in sheep’ conducted by HRD section at Animal Biotechnology Section of CSWRI on 1 April 2013.
3. Dr. Chanda Nimbkar visited Mr. Bernard Philip, Deputy Australian High Commissioner to India on 3 April 2013, along with Prof. Stephen Walkden-Brown of the University of New England, Armidale, Australia. They gave him information on the progress of the Australian Centre for International Agricultural Research (ACIAR) funded project on genetic improvement of Deccani sheep for meat production implemented by NARI.
4. Dr. Chanda Nimbkar and Prof. Stephen Walkden-Brown of the University New England had a meeting with the Hon. Union Minister for Agriculture, Shri Sharad Pawar on 3 April 2013. This meeting was to briefly summarise to the Hon. Minister the findings of the adoption study of the ACIAR-funded project for developing more productive sheep, carried out by NARI from 2003 to 2007 and exchange views on pathways for maximizing impact.
5. Dr. Chanda Nimbkar, as a member of the Research Advisory Committee of the Project Directorate of Foot and Mouth Disease, Mukteshwar, Uttarakhand, attended the RAC meeting on 11 April 2013.
6. Dr. Bhupesh Nandeshwar, Ms. Megha Patil and Mr. Vilas Bhagwat attended the 43<sup>rd</sup> Annual Group Meeting of Sorghum Workers held at the Directorate of Sorghum Research (DSR), Hyderabad from 20-22 April 2013.
7. Dr. Anil K Rajvanshi attended the Jamnalal Bajaj Awards selection committee meeting in Mumbai, 13 May 2013 to select awardees for Application of Science and Technology for rural applications.
8. Dr. Chanda Nimbkar, a member of the ‘Expert Committee on small ruminants’ of the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture,

Government of India attended meetings of the committee at New Delhi on 22 April, 3 June and 15 July 2013.

9. Dr. Chanda Nimbkar, as a member of the Academic Research Council of the Karnataka Veterinary, Animal and Fisheries Science University, attended a meeting of the ARC at Bidar, Karnataka on 27-28 May 2013.
10. Dr. Chanda Nimbkar attended a meeting of the Advisory Committee of the FAO-funded project on ‘Breed Conservation’ at the campus of WOTR at Darewadi in Ahmednagar district on 4 July 2013. This meeting was held during the ‘Learning programme on developing Bio-Cultural Protocols’.
11. Dr. Chanda Nimbkar, as a member of the Board of Management of the National Dairy Research Institute, attended a meeting of the BOM at Karnal, Haryana on 6 July 2013.
12. Dr. Vrijendra Singh, Mr. Mukund Deshpande and Dr. Sachin Khedekar attended the Annual Group Meeting of Safflower and Linseed of the All India Coordinated Research Project (AICRP) on oilseeds held on 29-31 August 2013 at the Nimbkar Agricultural Research Institute, Phaltan and presented the annual progress report of the safflower research at NARI.
13. Dr. Chanda Nimbkar attended a group meeting of goat rearers from all over Maharashtra organised by Mr. Prithviraj Chavan, a goat farmer of Vitthalwadi, Kavathe, Tal. Wai on 1 September 2013. She was invited as an advisor. The points discussed in the meeting were challenges and future strategies for the business of goat rearing. It was decided in the meeting to establish a goat and sheep producers’ federation.
14. Dr. Chanda Nimbkar attended the Annual Review Meeting of the All India Coordinated Research Project on Goat Improvement organised by the Central Institute for Research on Goats, Makhdoom, U.P. at Mahatma Phule Krishi Vidyapeeth, Rahuri on 6-7 September 2013 and presented the annual progress report of the Osmanabadi Field Unit of NARI.
15. Dr. Chanda Nimbkar, as a member of the Editorial Board of The Indian Journal of Animal Sciences, attended a meeting of the Board, organised by the Directorate of Knowledge Management in Agriculture, ICAR, New Delhi on 16 September 2013.
16. Dr. Chanda Nimbkar visited the Secretary, Government of India, Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Mr. Anup Kumar Thakur on 16 September 2013. She gave him information about the progress of the project for setting up a ‘State of the Art A. I. Centre for sheep and goats’ sanctioned by his department in November 2010 and also information about other activities of the Institute.
17. Dr. Chanda Nimbkar attended the 20<sup>th</sup> Conference of the Association for the Advancement of Animal Breeding and Genetics (AAABG) held at Napier, New Zealand on 20-23 October 2013. She received the Vercoe Family grant to cover her return travel to the conference, registration and accommodation charges. She presented a paper at the conference in the ‘John Vercoe Memorial’ session.
18. Dr. Chanda Nimbkar attended the first meeting of the advisory committee for the ‘Programme of supporting the production of genetically improved goats through open

nucleus breeding as a part of the Rajasthan Agricultural Competitiveness Programme (RACP) funded by the World Bank, held at Jaipur, Rajasthan on 13 November 2013.

19. Dr. Nandini Nimbkar, as a member of the Research Advisory Committee (RAC) of the National Institute of Abiotic Stress Management (NIASM), Malegaon attended the third RAC meeting on December 6, 2013. She was accompanied by Mr. B. V. Nimbkar, the founder-president. They gave a short presentation on NARI's work of grassland development to the NIASM scientists.
20. Dr. Vrijendra Singh attended safflower germplasm-cum-breeders field day on December 27, 2013 at AICRP (Safflower), M.P.K.V. Solapur.
21. Dr. Chanda Nimbkar attended a meeting held under the chairmanship of Shri T. B. Jayachandra, Hon'ble Minister for Law, Human rights, Parliamentary Affairs and Animal Husbandry, Karnataka regarding improving performance of sheep and goats in Karnataka state organised by Karnataka Sheep and Wool Development Corporation Ltd. on 14 January 2014 at Gulbarga, Karnataka.
22. Smt. Padmaja Ghalsasi attended the XXIV National Congress of Veterinary Parasitology and National Symposium on 'Towards Food Security through Sustainable Animal Production and Integrated Parasite Management' held at College of Veterinary and Animal Sciences, Mannuthy, Kerala on 5-7 February 2014. She presented the paper 'Assessment of the FAMACHA<sup>®</sup> anaemia guide card in sheep and goats in Maharashtra'.
23. Dr. Vrijendra Singh attended NFBSFARA-sponsored Project Proposal Development Workshop, for development of full proposal of NFBSFARA accepted concept note on developing high oleic safflower genotypes through functional genomics submitted by NCL, Pune in collaboration with NARI and center for Innovation in nutrition Health and Disease, Bharati Vidyapeeth, Pune, at National Academy of Agricultural Research Management, Rajendranagar, Hyderabad from 24-26 March 2014

#### **IV. TRAINING AND EXTENSION ACTIVITIES**

**Training:** During the year, the AHD conducted the following 14 training courses. The major lecturers during the 'goat and sheep management' courses were given by Dr. P.M. Ghalsasi, Dr. Chanda Nimbkar and Ms. Padmaja Ghalsasi while the practicals were conducted by Mr. K.M. Chavan, Mr. Rupsing Khanvilkar and Mr. Dattatray Mulik. The AI training courses were conducted (both lectures and practicals) by Dr. P.M. Ghalsasi with the help of our livestock farm supervisors.



<b>Sr. No.</b>	<b>Date</b>	<b>Subject</b>	<b>Participants</b>
1.	18-20 April 2013	Goat Management and Artificial Insemination in Goats	Shri Subhash Mawale and Shri Pradip Kasal from Taluka Parner, Dist. Ahmednagar, Mr. Tejas Patil from Taluka Bhivandi, Dist. Thane, and two staff members of AHD, Shri Vijay Khomane and Ms. Sanjana Atole
2.	23-24 April 2013	Artificial insemination in goats.	Twelve Government Livestock Development Officers and one Asst. Livestock Development Officer from Osmanabad, Aurangabad and Solapur districts deputed by the Department of Animal Husbandry, Government of Maharashtra.
3.	25-26 April 2013	Artificial insemination in goats.	Ten Livestock Development Officers and two Asst. Livestock Development Officers from Buldhana and Ahmednagar districts deputed by the Department of Animal Husbandry, Government of Maharashtra.
4.	17-21 June 2013	Goat Management and Artificial Insemination in Goats	Eight women Asst. Veterinary Field Officers, one Veterinary Assistant Surgeon and one Project Director of Bastar Integrated Livestock Development Project, Jagdalpur, Chattisgarh.
5.	11-13 July 2013	Commercial Goat and sheep production technology	Nine farmers from Babhaleshwar, Dist. Ahmednagar sponsored by Krishi Vigyan Kendra (KVK), Babhaleshwar under ATMA training program. Dr. Vitthal Vikhe, Veterinary officer, KVK also attended the course.
6.	6-8 August 2013	Commercial Goat and sheep production technology	Three women goat owners from Taluka Mann, Dist. Satara sponsored by the Manndeshi Foundation and two staff members of 3J Agro Pvt. Ltd., Village Rui, Taluka Koregao, Dist. Satara.
7.	23-24 August 2013	Artificial insemination in goats	This program was organised on the Vijay Farm at village Polur in Tamil Nadu. Dr. Pradip Ghalsasi gave training to a group of 70 farmers.

8.	30-31 October 2013	First aid in goats and sheep	Six staff members of AICRP on Osmanabadi goat at NARI. Two other participants were Smt. Surekha Kalel from Mann Deshi Foundation, Mhaswad, Tal Man and Shri Sagar Chatur, Rajapur, Tal Khatav, Dist. Satara.
9.	19-21 December 2013	Sheep Management	Three staff members of Essar Agrotech Ltd., Talegaon Dabhade, Dist. Pune.
10.	31 December 2013 to 8 January 2014	Goat management and first aid in goats	Ten members of Self Help Groups from Village Wadgao, Tal. Phaltan under the AICRP on Osmanabadi goat. The course was held for one hour every evening in Wadgao.
11.	4 January 2014	Artificial insemination in goats	Eight MSc/PhD students and two Professors of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, M.S.
12.	10 January 2014	NARI Nirbeeja Subabhu grafting	Shri Ananda Hubale, Nagole, Tal. Kavathemahankal, M.S.
13.	10-14 February 2014	Improved management and artificial insemination in sheep and goats	Nine officers from Dept. of Animal Husbandry and Veterinary Service and Karnataka Sheep and Wool Development Corporation Ltd., Karnataka.
14.	15 February 2014	Seed production demonstration of TGMS-based safflower hybrid NARI-H-23	Shri. Santosh Kumar from Marico Ltd., Gulbarga, Karnataka
15.	18-20 February 2014	Commercial Goat and sheep production technology	Nine farmers from Taluka Digras, Dist. Yawatmal (under ATMA training program of Taluka Krishi Adhikari Karyalaya, Digras) and Manager of M.D. Goat Farm at Mahud, Dist. Solapur.

#### Extension activities:

**A. Dissemination of animals :** The following FecB carrier breeding rams and ewes were supplied to sheep owner individuals and organizations during the year.

Sr. No.	Date	Name of the person	No. of animals supplied			
			Rams		Ewes	
			$FecB^{BB}$	$FecB^{B+}$	$FecB^{BB}$	$FecB^{B+}$
1.	20 April 2013	Shri Ashish Desai, Mumbai, MS	-	2	-	-
2.	3 June 2013	Shri Jayant S. Gokhale, Thane, MS	-	3	-	-
3.	24 June 2013	RKVV Project – Department of Veterinary Gynaecology and Obstetrics, Veterinary College, Hebbal, Karnataka	10	-	-	-
4.	9 July 2013	Shri Gurumurthy, Circle Nevenagar, Bagalkot, Karnataka	-	3	-	4
5.	17 August 2013	Mr. Kevin D'Sa, Aundh, Pune, MS	-	1	-	-
6.	27 September 2013	RKVV Project – Department of Veterinary Gynaecology and Obstetrics, Veterinary College, Hebbal, Karnataka	8	-	-	-
7	13 November 2013	Director of Research, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka	3	-	-	-
8.	8 February 2014	Mr. Abdul Rauf A. Shaikh Banvasi, Tal. Sirsi, Karnataka		1	5	7
9.	26 March 2014	Smt. Suwarna Vikramsinh Tapkir	-	2	4	11
10.	29 March 2014	Director of Research, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka	3	-	-	-
Total			24	12	9	22

$FecB^{BB}$  = homozygous,  $FecB^{B+}$  = heterozygous

## **B. Frontline demonstrations :**

Fourteen Frontline demonstrations in safflower were successfully carried out to transfer the improved varieties/hybrids and technology of safflower production to farmers during Rabi 2013-14.

## **C. Exhibitions**

This year AHD participated in the following livestock exhibitions. A stall was provided to AHD free of cost to display boards of its activities and provide information about the availability of frozen semen straws of outstanding bucks of Boer, Osmanabadi, Damascus cross and Alpine and Sannen X Beetal bucks and other activities of AHD to visitors in all three exhibitions.



1. ‘Pashudhan - Indian Livestock Industry Fair 2013’ organised at Deccan College ground, Pune, Maharashtra on 21-23 October 2013. AHD supported Kisan Forum Pvt. Ltd., Pune as conceptual Sponsor for this exhibition. Shri Kanhaiya Chavan and Smt. Bharati Pawar were present at the stall.
2. ‘Krushidhan Agro Expo 2013’ organised by the Vivid Events Pvt. Ltd., Mumbai at Latur, Maharashtra from 27 November to 1 December 2013. Shri Kanhaiya Chavan and Shri Sunil Kulkarni were present at the stall.

3. Mandeshi Agriculture and Livestock exhibition organised by Anilbhau Desai Yuva Foundation at Dahiwadi, Tal. Man, Dist. Satara. Shri Kanhaiya Chavan and Shri Vikram Shedge were present at the stall. Shri Chavan delivered a lecture on ‘Improved goat and sheep development’ to the farmers who attended the seminar organised at the time. One Boer buck and one NARI Suwarna ram were displayed in the exhibition.
- D. Shri Navnath Patange and Smt. Bharati Pawar visited Dahiwadi branch of Mann Deshi Foundation on 11 December 2013 to teach goat owners’ data entry in the Data Base program developed by AHD to two staff members of Mann Deshi Foundation, Smt. Banu Bangar and Smt. Swapnali Kadamb.
- E. As per mutual understanding with Mann Deshi Foundation, Mhaswad, Dist. Satara in Maharashtra a synchronisation and artificial insemination program was organised by AHD. Dr. Pradip Ghalsasi carried out ultrasonography of a total of 76 goats which belonged to women goat owners in Jambhulni and Pulkoti villages of Mann Taluka on 13 December 2014. CIDRs were inserted for oestrus synchronization into 25 non-pregnant does found to be suitable for this programme. CIDRs were removed after 17 days and PMSG injections were given to these goats. These goats were inseminated using frozen semen of Boer, Damascus cross and Alpine x Beetal bucks. Dr. Ghalsasi did Ultasonography of 23 goats on 1 January 2014 for pregnancy diagnosis and found that 8 goats were pregnant. One goat was not brought for ultrasonography.
- F. On 19-25 November 2013 Dr. P. M. Ghalsasi visited the African Goat Improvement Project in Uganda, established by the British Organization Doles Ffermio. He accompanied Dr. Lorna Brown of Wales. They carried out embryos transfers in Ugandan

goats. Dr. Ghalsasi also trained the project personnel in Uganda in the technique of buck semen freezing.

#### G. Dissemination of seeds and other products

The following products were disseminated to farmers and for research purposes during the last year.

Sr. No.		Quantity (kg)
<b>Safflower seed</b>		
1.	NARI-38	222
2.	NARI-6	198
3.	NARI-52	140
4.	NARI-H-15	35
5.	NARI-NH-1	34
6.	NARI-57	32
7.	Nira	2.5
8.	MSV-10-1-5 (Parent)	18.2
9.	GMU-2369 (Parent)	8.2
10.	TMS-3-1-9-1 (Parent)	5.7
11.	D-152-12 (Parent)	3.5
12.	MMS white (Parent)	0.7
13.	C-2829-5-3a-6	0.7
14.	NARI-H-23	0.4
15.	Experimental varieties and hybrids	18
<b>Total</b>		<b>718.9</b>
<b>Sweet sorghum seed</b>		
1.	Madhura	140
2.	NARI-SS-1041A (Parent)	0.2
3.	NARI-SS-52A (Parent)	0.2
4.	NARI-SS-296A (Parent)	0.2
<b>Safflower petal herbal tea</b>		60
<b>Madhura sweet sorghum syrup</b>		62

- H. Weather data was provided during the year to Baramati Agro Sugar Ltd., Shetphalgade; Kay Bee Exports, Phaltan; Rupali S. Jadhav, Phaltan and Ashwini Kumbhar and Akshda Kadamb from College of Agriculture, Phaltan.

#### V. TRAINING RECEIVED BY NARI STAFF

1. Dr. Pradip Ghalsasi, Buck Semen Freezing Centre In-charge, visited France and spent time at the following centres from 28 May to 8 June 2013 to obtain in-depth knowledge about buck semen freezing protocols and artificial insemination (A.I.) in goats.
  - a. Research and Extension Centre of Institut National de la Recherche Agronomique (INRA): the apex French agricultural research organization.

- b. Capgene Selection centre: An industry structure, owned by cooperatives. All frozen buck semen for France is produced in this centre.
- c. Genoe-Creavia: A Cooperative that carries out goat A.I. in France. Goat A.I. is used on a large scale in France.

The knowledge he acquired is useful to improve the quality of the semen produced in the semen freezing laboratory at AHD and also useful to formulate SOP for buck semen freezing and A.I. in India.

We are grateful to all the organizations for giving training to Dr. Ghalsasi without any charge.

- 2. Dr. Bhupesh Nandeshwar attended a training programme entitled “Basics of Sorghum Breeding and AICSIP data management” from 23-24 August 2013 at the Directorate of Sorghum Research (DSR), Hyderabad.
- 3. Dr. Bhupesh Nandeshwar attended the fourth International training course on “Sorghum hybrid parents improvement and seed production” from 30 September to 11 October 2013 at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh.
- 4. Dr. Bhupesh Nandeshwar attended the ICAR-sponsored Winter School on “Molecular Breeding Approaches for Genetic Enhancement of Millet Crops” from 6-26 January 2014 at the Directorate of Sorghum Research (DSR), Hyderabad.

## **VI. VISITORS TO THE INSTITUTE**

### **1. Visits by individuals during the year to see research and development activities of NARI**

Sr. No.	Date	Visitor's name	Visitor's organisation or place	Purpose of visit
1.	29 March to 5 April 2013	Prof. Stephen Walkden-Brown	University of New England, Armidale, Australia	To do a post-project adoption study of the ACIAR-funded project "Improved productivity, profitability and sustainability of sheep production through genetically enhanced prolificacy, growth and parasite resistance" implemented by NARI, AHD in India from 2003 to 2008.
2.	2 April 2013	Shri. D. R. Thavai Chief Manager (Admin)	State Bank of India, R.B.O., Satara	To obtain general information of goat-sheep rearing to enable them to pass on better knowledge to borrowers who are interested in the activity.
3.	4 April 2013	Dr. H. T. Kangale, Regional Manager and his colleague Dr. Bade	Animal Husbandry, Frozen Semen Laboratory, Khadaki, Pune	To see buck frozen semen laboratory of AHD.
4.	12 April 2013	Dr. B. R. Bhosrekar Frozen semen technology expert.	-	Dr. Pradip Ghalsasi had technical discussions with him about setting up a buck frozen semen laboratory.
5.	12 April 2013	Shri. Kiran Shelar, Executive Editor with two colleagues	Tarun Bharat newspaper, Mumbai	To get information about the goat and sheep rearing in view of self employment.
6.	25-26 April 2013	1. Dr. K.M.L. Pathak, DDG (AS), 2. Dr. S. K. Singh, IC, AICRP project on goat improvement – PC Unit	1. ICAR, New Delhi 2. Central Institute of Research on Goats (CIRG), Makhdoom, UP.	To see the progress of the AICRP on Osmanabadi goat field unit at NARI and to familiarize themselves with the research and development activities of AHD.
7.	29 April 2013	1. Dr. Kamlesh Trivedi, General Manager (Productivity)	1. National Dairy Development Board, Karnal, Haryana. 2. World Bank	To get information on the research and development activities of AHD. Mr. B.V. Nimbkar, Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi talked to them.

		Enhancement) 2. Dr. Helen Leitch, Livestock Expert for South Asia, World Bank 3. Dr. Kankal	3. Maharashtra Agricultural Competitiveness Project, Pune	
8.	30 April 2013	Shri. Sachin Patwardhan	Sir Dorabji Tata Trust, Mumbai	To seek advice for crop improvement and goat improvement programs in villages through Tata Trust. He had discussion with Shri B. V. Nimbkar, Dr. Chanda Nimbkar and Dr. Nandini Nimbkar
9.	3-4 May 2013	1. Dr. S. V. Singh, Principal Scientist and head 2. Dr. Sarang Desai, MVSc student	1. Animal health division, CIRG, Makhdoom 2. Post-Graduate Institute, Akola under MAFSU	To conduct a clinical trial of a vaccine against Johne's disease in sheep and goats.
10.	7 May 2013	Sandeep R. Kumbhar	Ph.D. student, Phaltan	He came to get guidance from Dr. Rajvanshi about his Ph.D. research topic.
11.	7 May 2013	G. V. Baratkar	Bharat Heavy Electricals Ltd., Hyderabad	To discuss about biomass power generation with Dr. Rajvanshi.
12.	16 May 2013	R. S. Alase and Smita R. Alase	Kolhapur	To learn about research and development activities at NARI
13.	20 May 2013	Abhas Bhalla and Deepak Tonk	Mumbai	Visited to prepare a film on NARI activities.
14.	23 May 2013	Ranjeet Shanbhag with his colleague	Vigyan Ashram, Pabal	Dr. Rajvanshi gave information about NARI's work in the field of renewable energy and showed them the different technologies developed.
15.	26 May 2013	Priyanka Jaju	ALZEA (France-based organization partnering with the best business and engineering schools in France and	To visit the graduate Rachel Nanette and see the progress of her internship at NARI.

			Belgium), Pune	
16.	29 May 2013	Ravsaheb Yewale and his colleague	Savedi, Dist. Ahmednagar	To learn about research and development activities at NARI
17.	14 June 2013	Dr. S. Ayyappan, Director General	ICAR, New Delhi	To familiarize himself with the research and development activities of AHD and to see progress of the AICRP on Osmanabadi goat field unit at NARI. Dr. Chanda Nimbkar, Shri B.V. Nimbkar and Dr. Pradip Ghalsasi had discussions with him. He was shown around the farm and laboratories. Later on he visited the NARI head office where Dr. Nandini Nimbkar gave a presentation regarding research activites of NARI in safflower, sweet sorghum and renewable energy, which was followed by discussions.
18.	15 June 2013	Pramod Desai Kaustubh Avhale Nitin Tanpure Mangi Singha	Pune	To discuss with Dr. Rajvanshi about various projects on renewable energy
19.	24-25 June 2013	Dr. John Copland, former Research Program Manager	Australian Centre for International Agricultural Research (ACIAR), Australia	To see post progress of the ACIAR-funded project on sheep improvement.
20.	27 June 2013	Dr. Jagadish Rane, Head, Division of Drought Stress Management Dr. D. V. Patil, Senior Scietist (Plant Breeding) Dr. Ratnakumar Pasala Senior Scientist (Plant Physiology)	National Institute of Abiotic Stress Management (NIASM), Baramati	To discuss about sowing of a guar trial on NARI farm.
21.	5 July, 19 October 2013	Dr. Jagadish Rane Dr. D. V. Patil	NIASM, Baramati	To inspect the arrangements and for sowing the guar trial.

22.	6 July 2013	Smt. Vanita Shinde, CEO, Sunita Tarlekar, Business School Coordinator and three women goat rearers	Mann Deshi Foundation, Mhaswad, Taluka Mann, Dist. Satara	Shri B.V. Nimbkar, Dr. Nandini Nimbkar and Dr. Pradip Ghalsasi had discussions with them about goat rearing in Mann taluka and training of goat keepers.
23.	22 July, 22 August 2013	Dr. Jagadish Rane	NIASM, Baramati	To see the guar trial.
24.	22 July 2013	Sachin T. Pawar	Munjawadi, Tal. Phaltan	To see the alchol stove.
25.	27 July, 14 August 2013	Yogesh Salunkhe Rohit Chowgule Pankaj Salgare Abhishek Singhal Krishna Patil	DKTE Society's Textile and Engineering Institute, Ichalkaranji	To discuss with Dr. Rajvanshi their final year project in renewable energy.
26.	27 July 2013	Piyush V. Godse Kedar R. Patrekar Viraj P. Gaikwad	Kamala Nimbkar Balbhavan, Phaltan	To collect information about electric vehicles.
27.	31 July 2013	Swati Besci Vijaya Bambe Pramod Bawne	Pune	To get information about renewable energy research at NARI.
28.	July 2013	Dr. N. Vyas, Vice Chancelor (Formerly head, Department of Mechanical Engineering IIT Kanpur)	Rajasthan Technical University, Kota	He discussed various issues in renewable energy and precision agriculture with Dr. Anil Rajvanshi and Dr. Nandini Nimbkar for 1.5 days.
29.	2 August 2013	Santoshkumar, Vaibhav Kulkarni, Aman Jyoti	Marico Ltd., Mumbai	To give us information about the performance of NARI-57 and NARI-52 at farmers' fields during Rabi 2012-13.
30.	6 August 2013	Dr. D. Pati	Scientific Officer, Directorate of Oilseeds Research (DOR), Hyderabad	To discuss preparations of group meetings with Dr. Vrijendra Singh.
31.	22 August 2013	V. C. Kakade with four colleagues	Tuljaram Chaturchand College (T.C.), Baramati	They held discussions with Dr. Singh and AHD about supply of data for analysis to their students.
32.	23 August	Smt. Chetna Sinha,	Mann Deshi Foundation, Mhaswad,	Dr. Chanda Nimbkar, Dr. Nandini Nimbkar and Shri B.

	2013	Chairman and her colleagues Smt. Vinita Shinde, CEO, Sunita Tarlekar, Business School Coordinator and Ashwini Hol	Maharashtra.	V. Nimbkar had discussions with them about providing facilities to increase productivity of goats in Mann Taluka under the guidance and with support from AHD.
33.	7 September 2013	1. Shri Ramrao Wadkute, Chairman 2. Dr. D. M. Chavan, Managing Director	Punyashlok Ahilyadevi Maharashtra Sheep and Goat Development Corporation, Pune	Dr. Ghalsasi gave information about AHD's work and showed him semen freezing laboratory.
34.	12 September 2013	Dr. D. V. Patil and Dr. D. K Nageswara Rao, Senior Scientist (Soil Chemistry)	NIASM, Baramati	To see the guar trial and discuss with Mr. Sharad Choudhari about the disease control measures.
35.	16 September 2013	Sachin Narayan Jagtap and Nana Chavan	Pargaon Khandala, Dist. Satara	To see manufacturing of sweet sorghum syrup.
36.	17 September 2013	Abdul Bagwan	Paithan, Dist. Aurangabad	To get information on Lanstove and see if a manufacturing unit can be set up.
37.	17 September 2013	N. B. Patil with two colleagues	Bhuinj, Tal. Wai	Wanted to explore the possibility of using a gasifier for manufacturing jaggery.
38.	23 September 2013	Rajat Madan Ashwini Kumar Ashutosh Bhakuni	Tata Institute of Social Sciences (TISS), Mumbai	Discussed with Dr. Rajvanshi about the different avenues for social entrepreneurship.
39.	3 October 2013	Dr. V. R. Bhagwat, Principal Scientist (Entomology) Dr. G. Shyam Prasad, Principal Scientist (Agricultural Entomology) Dr. S. Ravikumar Senior Scientist	Directorate of Sorghum Research, (DSR), Hyderabad	They visited for monitoring the progress of Kharif 2013 programme of the All India Coordinated Sorghum Improvement Project (AICSIP) at NARI.

		(Agronomy)		
		Dr. Y. D. Narayana Plant Pathologist	University of Agricultural Sciences, Dharwad	
40.	8 October 2013	Prof. V. C. Kakade and Prof. Patil together with Statistics Dept. students	T. C. College, Baramati	A Memorandum of Understanding for one year was signed by NARI, AHD to provide suitable data sets to BSc, MSc and PhD students of the Department of Statistics of T.C. College to analyze to fulfill their degree requirements.
41.	21 October 2013	Dr. D. V. Patil	NIASM, Baramati	For harvesting of guar trial.
42.	23 October 2013	Pratapsinh Nimbalkar	Phaltan	For safflower demonstration.
43.	28 October 2013	Lauren Howe	Hamilton College, Clinton, NY, USA	A 2013-14 Thomas J. Watson fellow, Lauren Howe is pursuing her independent research project "The Future of Food : Modern Technology and Traditional Agriculture Systems". In relation to this she held discussions with Dr. Nandini Nimbkar, Dr. Anil K. Rajvanshi and other NARI scientists.
44.	28-29 October 2013	1. Shri T. B. Jayachandra, Minister 2. Eight Officers 3. Dr. Nadeem Fairoze, Professor 4. Four Agri-businessmen	1. Minister for Law, Human rights, Parliamentary Affairs and Animal Husbandry, Karnataka 2. Dept. of Animal Husbandry and Veterinary Sciences, Karnataka and Karnataka Sheep and Wool Development Corporation 3. Dept. of Livestock Products Technology, Veterinary College, KVAFSU, Karnataka 4. Karnataka	Shri. B. V. Nimbkar and Dr. Pradip Ghalsasi gave information about the AHD's activities and showed them the farm and laboratories. They had discussions regarding services that can be provided by AHD to Karnataka govt. They visited Lundy farm to see nucleus flock of NARI Suwarna ewes and a shepherd's flock at Bhadali, Tal. Phaltan to see FecB carrier ewes. They also visited Boer and Sirohi goat farms of Nimbkar Seeds Pvt. Ltd. at Phaltan. They requested cooperation from AHD in training of vets and farmers, supply of frozen semen of goats and supply of FecB carrier rams.

45.	30 October 2013	Dr. Partha R. Dasgupta	Syngenta Foundation for Sustainable Agriculture	To discuss terms of reference of the proposed cooperation between NARI and Syngenta Foundation.
46.	31 October 2013	Amitabh Tripathi, Director	Indovision Media, Mumbai	He shot short film clips on NARI's research.
47.	8 November 2013	Pravin Yedurkar Pankaj Jadhav Dhiraj Jadhav	TISS, Mumbai NIT, Rourkela TISS, Mumbai	To get information about renewable energy sources for sustainable rural development.
48.	11 November 2013	K. P. Thomas	Kancor Ingredients Ltd., Cochin, Kerala	To discuss the availability of safflower flowers from farmers and visit NARI safflower plots.
49.	13 November 2013	Sanchit Singhal Vivek Gera	Australia	Discussed with Dr. Rajvanshi renewable energy prospects for starting a company in India.
50.	21 November 2013	Prof. A. K. Misra, Vice Chancellor with Associate Professor and other delegates	Maharashtra Animal and Fishery Sciences University, Nagpur.	Dr. Chanda Nimbkar gave information about the AHD's activities and showed them the farm and frozen semen laboratory. They had discussions regarding future collaboration between the two institutions.
51.	22 November 2013	1. Shri Ashok Kale and Smt. Meena Kale 2. Shri Kamlesh Karle, CEO with his colleague Shri Vitthal Bagwati	1. Ahmednagar Goat Federation Ltd, Ahmednagar 2. Essar Agrotech Limited, Mumbai	They had discussions with Dr. Chanda Nimbkar about setting up a large sheep farm at Talegaon by Essar Agrotech Ltd.
52.	23 November 2013	Vijay Mahadik Kamlakar Fartade	Akluj	To take safflower seed for Ph.D. research project and show their M.Sc. thesis for which NARI had provided seeds.
53.	24 November 2013	L. K. Murkute	Gangakhed, Dist. Parbhani	He wanted to purchase the Lanstove but was told that commercial production has not commenced yet.
54.	5 December 2013	Amol Rawate Sandip Adik	MAEER's MIT, Pune	To get information about work being carried out at NARI.
55.	5 December 2013	Ms. A. N. Deshmukh	BVG India Ltd., Pune	To get information about gasifier and other innovations of NARI.

56.	16 December 2013	Shri. Manab Chakraborty, Goat and Sheep breeder Ira Chakraborty, Partner	Prosperity Society, New Delhi.	To get information about goat and sheep improvement programs of AHD. Mr. Chakraborty had discussions with Dr. Chanda Nimbkar regarding promotion of goat rearing in Mewat, Haryana.
57.	16, 18, 19, 20 and 25 Decemebr 2013	Harshwardhan Kulkarni Ranjit Adale Rakesh Wagh	North Maharashtra University, Jalgaon	They were provided data by Dr. Singh for statistical analysis as a part of their Masters projects.
58.	17-18 December 2013	Dr. Mahesh Shivanand Dige, Scientist	Scientist, CIRG, Makhdoom, UP	Visited AICRP Osmanabadi goat field unit at Sakat village in Ahmednagar District to see field activities of NARI. He was shown around farms and laboratories.
59.	17 December 2013	Dr. M. J. Kaledhonkar, Principal Scientist (Soil and water cons. engg.) Dr. D. D. Nangare, Scientist (Soil and water cons. engg.)	NIASM, Baramati	They discussed with Mr. B. V. Nimbkar and Dr. Nandini Nimbkar about soil conservation research that can be carried out at NIASM.
60.	19 December 2013	Deepak V. Suchde and Vishwas	Malpani Trust, Bajawada, Dist. Dewas, M. P.	They are Late Mr. Shridhar Dabholkar's followers and had come to get information on gasifier, safflower herbal tea and sweet sorghum jaggery.
61.	29 December 2013	1. Shri. Anup Kumar Thakoor 2. Dr. Sanjay Bhoosreddy 3. Shri. Eknath Dawale with his associates	1. Secretary, Department of Animal Husbandry, Dairying and Fisheries (DADF), GOI 2. Joint Secretary, DADF, GOI 3. Commissioner, Animal Husbandry, Maharashtra	To inspect 'State of the art A.I. Centre' established at NARI funded by DADF, GOI. They were shown NARI Suwarna sheep and Boer goats. They had discussions with Dr. Chanda Nimbkar regarding technique of artificial insemination in goats. They also visited Boer goat farm of Nimbkar Seeds Pvt. Ltd. in Phaltan.
62.	30 Decemebr 2013	Rahul Singhal	Indraprastha Institute of Information Technology, New Delhi	To explore the possibility of doing Ph.D. under the guidance of Dr. Rajvanshi.
63.	6 January 2014	Dr. R. D. Prasad, Principal Scientist (Pathology)	DOR, Hyderabad	To monitor the safflower programme carried out at NARI during Rabi 2013-14.

		Dr. S. B. Ghuge, Breeder, AICRP	Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani	
64.	10 January 2014	Dr. G. V. Murli Krishna and Dr. K. N. Thimmana, Veterinary Officers	Veterinary Hospital, Challakere, Tal. Anekal, Karnataka	Purchased frozen semen straws of Osmanabadi, Damascus cross and Alpine cross Beetal bucks. They were given information about AHD's activities and also shown the farms.
65.	10 January 2014	Dr. Babu Beri with four farmers	Assistant Director (AH), Department of Animal Husbandry, Hyderabad, A.P.	To get information about goat and sheep improvement programs of AHD. They had discussions with Shri B.V. Nimbkar and Dr. Pradip Ghalsasi about dissemination of improved breeds of goats and sheep in Andhra Pradesh.
66.	13 January 2014	Kedarsinh V. Phadtare	Department of Chemical Engineering, Mumbai University	He was given information about solar distillation of ethanol by Dr. Rajvanshi.
67.	16 January 2014	Pravin Awatade Amol Karale Shriyash Bagal	TPCT's College of Engineering, Osmanabad	Dr. Rajvanshi advised them about academic project that they can do about gasifier.
68.	17 January 2014	Sadashiv Pandit, Chairman and four engineers and managers	Fleetguard Filters Pvt. Ltd., Pune	Dr. Rajvanshi gave them information about gasification and Lanstove research at NARI.
69.	23 January 2014	Shri. Sanjay U. Deshmukh with his colleagues	Former State Minister, Govt. Of Maharashtra, Digras, Dist Yawatmal	To get detailed information for starting a goat /sheep farm with improved breeds.
70.	3 February 2014	Dr. Krishnaswamy with two PhD students	Professor and Head, Dept of Veterinary Gynecology and Obstetrics, Veterinary College, Hebbal, Bangalore	-
71.	4 February 2014	Dr. A. V. Umakanth Principal Scientist (Plant Breeding) Dr. Sanjana Reddy Senior Scientist (Plant Breeding)	Directorate of Sorghum Research (DSR), Hyderabad	They visited for monitoring the Rabi 2013 programme of the All India Coordinated Sorghum Improvement Project at NARI.
		Dr. Ashwathama, Physiologist	University of Agricultural Sciences, Dharwad	

72.	5 February 2014	Er. Rajesh Soni, Professor and Prof. Sarjeet Sooch, Director	Renewable Energy Center, Punjab Agricultural University, Ludhiana	Dr. Rajvanshi discussed about projects on renewable energy with them.
73.	6 February 2014	K. P. Thomas	Kancor Ingredients Ltd., Kochin, Kerala	Dr. Vrijendra Singh took him to the fields of safflower growers for possible collection of safflower flowers.
74.	6 February 2014	Dr. Vikas Mahatme and Dr. Sunita Mahatme	Mahatme Eye Bank, Eye Hospital, Mumbai	They want to establish a model stallfed sheep farm for shepherd community at Nagpur. They had discussion with Dr. Chanda Nimbkar and Dr. Pradip Ghalsasi about sheep farming.
75.	7 February 2014	K. B. Merudandan, Deputy Commissioner with three colleagues	Excise Department, Government of Karnataka, Belgaum	Dr. Rajvanshi gave them information about production of alcohol from sweet sorghum, its use for cooking and lighting and problems faced in dissemination of these technologies.
76.	17 February 2014	Shailesh Choudhari, Seed producer	Green Tech Fertilizers Pvt. Ltd., Bhavnagar, Gujarat	To get information about hybrid seed production of TGMS-based hybrid NARI-H-23 in the field
77.	5 and 28 February 2014	Vijay Jadhav	Fleetguard Filters Pvt. Ltd., Pune	To look at NARI's biomass gasifier.
78.	1 March 2014	Dr. G. M. Kote, Jr. Agronomist	AICRP (Safflower), VNMKV, Parbhani	To monitor safflower Frontline Demonstrations carried out by NARI during Rabi 2013-14.
79.	1 March 2014	Mohit Juneja Kasturi Gandhi Prathishta Chetri	Xavier's Institute of Communication, Mumbai	They wanted to make a film on NARI.
80.	6 March 2014	Dr. Y. Thirupathaiah with his colleague	Addl. Director, Animal Husbandry, Directorate of Animal Husbandry, Hyderabad, Andhra Pradesh.	To see research facilities and familiarize with the activities of the AHD. They visited Lundy farm to see nucleus flock of NARI Suwarna sheep.
81.	7 March 2014	Ramesh Bhoite	A/P. : Hingangaon Tal. : Phaltan	He was given information about honeybee boxes at NARI.
82.	10 March 2014	C. R. Khade	College of Agriculture, Phaltan	He was given information about sweet sorghum syrup making by Ms. Megha Patil.
83.	17 March	Deepak Kanhere and his	At Post : Sastewadi, Tal. Phaltan	He discussed biogas production with Dr. Rajvanshi.

	2014	colleague		
84.	21 March 2014	Santosh B. Sondakar	A/P : Mole, Tal. Athani, Dist. Belgaum, Karnataka	He was given information about the biomass gasifier.
85.	22 March 2014	Dr. John Gibson	Director of the Centre for Genetic Analysis and Applications and the Coordinator of International Development Activities of the School of Environmental and Rural Science, University of New England (UNE), Armidale, NSW, Australia	He was shown Frozen semen, Parasitology and Molecular Biology laboratories as well as nucleus flock of NARI Suwarna sheep at Lund farm and Dr. Chanda Nimbkar, Shri B. V. Nimbkar and Dr. Pradip Ghalsasi had discussions with him.
86.	28 March 2014	Dr. Sunil Kirloskar	Manipal Institute of Technology, Karnataka	To discuss renewable energy projects and explore possible employment opportunities.

## 2. Visits by groups during the year to see research and development activities of NARI

Sr. No.	Date	No. of persons	Type of group	Organized by
1.	3 April 2013	17	Animal Husbandry Officers.	Animal Husbandry Department of Orissa government.
2.	5 April 2013	51	Prof. Ratnaparkhe P. R. And his 50 students	Mudhoji College, Phaltan
3.	4 May 2013	16	Prof. S. D. Pawar and his 15 students of crop science	Maloji Raje Sheti Vidyalaya and Junior College, Phaltan
4.	7 May 2013	22	Self Help Group members and one officer.	Chaitanya Sanstha, Rajgurunagar, Tal. Khed, M.S.
5.	10 June 2013	9	BVSc girl students with Dr. Devendra Jadhav, Assistant Commissioner, Animal Husbandry, Satara district and Dr. Azad Kadarbhai, LDO, Veterinary Dispensary, Satara.	Bombay Veterinary College, Mumbai, M.S.
6.	22 July 2013	19	Manisha Shende, Vishal Shinde and 17 students of VII semester	College of Agriculture, Phaltan
7.	1 August 2013	70	Five staff members with 65 students	Cummins College of Engineering for Women, Pune
8.	11 August 2013	8	G. S. Kamble and his seven colleagues	Civil Hospital, Satara

9.	22 August 2013	8	Prof. V.C. Kakade and his five colleagues with two Statistic degree students.	Tuljaram Chaturchand College (TCC), Baramati, Maharashtra.
10.	31 August 2013	40	Participants of Annual Group Meeting on AICRP Safflower and Linseed.	The meeting was held at Nimbkar Agricultural Research Institute, Phaltan, M.S.
11.	12 September 2013	24	Women (farmers) and two officers.	O/o Dy. Director of Agriculture, Farmers Training Centre, Rajendranagar, Hyderabad, A.P.
12.	27 September 2013	46	Trainees under ATMA's 'Farmers training program'.	Krishi Samrudhi Prakalpa, Wardha, M.S.
13.	16 October 2013	25	Trainees under Regional Agricultural Management Training with Shri Nitin Fulsundar, Asst. Director.	Regional Agricultural Management and Training Institute, Pune, M.S.
14.	26 November 2013	52	Trainees under 'Goat Rearing' training program.	Krishi Vigyan Kendra, Shardanagar, Baramati, M.S.
15.	13 December 2013	10	Trainees under 'Goat Rearing' program.	MITCON and District Industrial Training Centre, Ahmednagar, M.S.
16.	24 December 2013	51	Farmers	Members of Bangalore Urban and Rural Districts Sheep Breeder's Association (R.), Karnataka.
17.	25 December 2013	105	Five teachers and 100 students	Dattakala International School and Junior College, Bhigwan, Dist. Pune
18.	27 December 2013	14	B.Tech., M.Tech. and Ph.D. students	Indian Institute of Technology, Bombay (To discuss with Dr. Rajvanshi possible renewable energy projects).
19.	6 January 2014	20	Farmers with two officers under ATMA's study tour	Taluka Agricultural Office, Shrigonda, Dist. Ahmednagar, M.S.
20.	9 January 2014	14	Veterinary Doctors with one staff member	Kasti Vividha Karyakari Seva Sahakari Society Ltd. Kasti, Tal. Shrigonda, M.S.
21.	10 January 2014	8	Six farmers with two officers.	Taluka Agricultural Office, Shrigonda, Dist. Ahmednagar, M.S.
22.	24 January 2014	55	Farmers under ATMA's study tour with one officer	Taluka Agricultural Officer, Tasgaon, Dist. Sangli, M.S.
23.	24 January 2014	40	Farmers with one officer	District Deputy Commissioner, Animal Husbandry, Satara, M.S.

24.	4 February 2014	53	Farmers with two officers	Livestock Development Officer, Veterinary Dispensary, Shirala, Dist. Sangali, M.S.
25.	7 February 2014	42	Farmers with two officers	Livestock Development Officer, Veterinary Dispensary, Shirala, Dist. Sangali, M.S. Kamdhenu Dattak Gram Yojana- study tour program of Maharashtra Government
26.	11 February 2014	52	Farmers with two officers	Livestock Development Officer, Veterinary Dispensary, Shirala, Dist. Sangali, M.S. Kamdhenu Dattak Gram Yojana- study tour program of Maharashtra Government
27.	12 February 2014	33	Farmers with two officers	Directorate of Extension, University of Agricultural Sciences, Dharwad, Karnataka
28.	13 February 2014	35	Farmers with two officers	Livestock Development Officer, Veterinary Dispensary, Shirala, Dist. Sangali, M.S. Kamdhenu Dattak Gram Yojana- study tour program of Maharashtra Government
29.	15 February 2014	33	Farmers with two officers	Livestock Development Officer, Veterinary Dispensary, Chikhali and Mangle, Dist. Sangli, M.S. Kamdhenu Dattak Gram Yojana- study tour program of Maharashtra Government
30.	17 February 2014	57	Livestock Supervisors	Panchayat Samiti, Satara and Thosegar, Dist. Satara, M.S. Kamdhenu Dattak Gram Yojana- study tour program of Maharashtra Government
31.	25 February 2014	83	Farmers with one officer	Livestock Development Officer, Veterinary Dispensary, Kudal, Dist. Satara, M.S. Kamdhenu Dattak Gram Yojana- study tour program of Maharashtra Government
32.	25 February 2014	50	Farmers with one officer	Livestock Development Officer, Veterinary Dispensary, Kidgaon, Mhaswe, Dist. Satara, M.S. Kamdhenu Dattak Gram Yojana- study tour program of Maharashtra Government

33.	27 February 2014	10	Members of Kasthi Vividh Karyakari Vikas Society 1.	Kasthi Vividh Karyakari Vikas Society-1, Kashti, Dist. Ahmednagar
34.	3 March 2014	37	MSW-II degree students.	Yashwantrao Chavan School of Social Work, Jakatwadi, Satara, M.S.
35.	5 March 2014	20	Women farmers from village Shirsatwadi , Tal. Indapur.	Mahila Arthik Vikas Mahamandal, Pune.
36.	6 March 2014	45	Farmers with one officer.	Veterinary Dispensary, Jihe, Dist. Satara
37.	8 March 2014	15	Dr. V. V. Aware and 14 students	College of Agricultural Engineering and Technology, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth
38.	13 March 2014	31	Mr. Pawar and 30 students	PDS Institute of Agriculture
39.	22 March 2014	50	Self Help Group members	District Coordinator Officer, Mahila Arthik Vikas Mahamandal, Zilha Parishad, Kolhapur.

## **VII. OTHER ACTIVITIES**

1. Mr. Kuldip Newase, Taluka Agricultural Officer, Phaltan purchased 30 copies each of our Marathi booklets ‘First-aid in goats and sheep’ and ‘Vaccination in goats and sheep’. He distributed these booklets to the participants of a goat rearing training program organised on 2-3 April 2013 by Agricultural Technology Management Agency (ATMA), Phaltan at the farm of Shri. Vitthal Shendge, Nine Circle, Tal. Phaltan.
2. AHD purchased three Alpine X Beetal and one Sannen X Beetal bucks on 16 May 2013 from the National Dairy Research Institute, Karnal, Haryana for introgression of dairy genes into local goats. AHD has made available frozen semen straws of these bucks for artificial insemination in local goats. The milk yield of mothers of these bucks was 2.5 to 3 litres per day.

## **VIII. STAFF APPOINTMENTS TO PRESTIGIOUS POSITIONS**

1. Dr. Chanda Nimbkar was nominated as a member of the National Steering Committee on National Livestock Policy constituted by the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India on 25 June 2013.
2. Rajiv Gandhi Science and Technology Commission, Government of Maharashtra appointed Dr. Chanda Nimbkar as a member of the Steering and Monitoring Committee for the project approved by them entitled ‘Maharashtra Gene Bank Programme in Maharashtra’ of Indian Institute of Science Education and Research, Pune with effect from 12 March 2014.
3. Dr. Chanda Nimbkar was nominated as a Member of the Research Advisory Committee of National Bureau of Animal Genetic Resources, Karnal for three years from 19 August 2013.