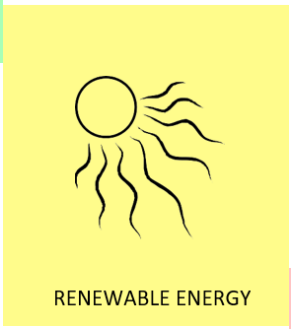
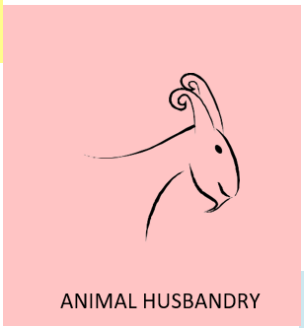
Annual Research Report

(2023-24)





NARI

Nimbkar Agricultural Research Institute
Lonand Road, Phaltan, Maharashtra

Contents

Report of the President

I am happy to present to you the NARI annual research report for 2023-24. Some important happenings of this year were as follows:

1. Dr. P. Balaram, former Director of IISc. Bengaluru and Padma Bhushan Awardee joined the board of NARI. The Institute feels honoured to welcome him and will tremendously benefit from his sage advice.

2. Work was initiated on the Tata project of providing clean drinking water to rural schools. This project of two-year duration is based on the unique drinking water technology (DWT) developed at NARI which includes rain water harvesting (RWH) and solar water purification (SWP).

3. A four days' entrepreneurship training course was organized by NARI-AHD for 10 students of the Guru Angad Dev Veterinary and Animal Science University (GADVASU). They were taught the 'Principles and practice of small ruminant genetic improvement.

4. A nice video clip of NARI work was shown on national TV on October 8, 2023. It was a part of the *"Hamare Padma"* series shown on Doordarshan.

5. Under the Osmanabadi Goat Field Unit of the ICAR-All India Coordinated Research Project on Goat Improvement, a one-day training course was organized by NARI-AHD for the goat-keepers and extension workers working in the participating villages of this project.

6. Dr. Anil K. Rajvanshi was the chief guest at the programmes which took place in the Bengaluru and Nashik facilities of Hindustan Aeronautics Ltd. He addressed the engineers and other staff at these sites.

7. During the year Dr. Rajvanshi gave two institute lectures (one in November 2023 and other in March 2024) at IIT, Kanpur his alma mater. He also gave an online talk to about 100 agritech start-up entrepreneurs organized by IIT Kanpur incubation cell.

8. Dr. Rajvanshi was one of the main speakers at the inauguration ceremony of the International Water conference organized by IIT Bombay in November 2023. He also delivered an Institute lecture at IIT Bombay on 4th December 2023.

9. Dr. Rajvanshi gave an inspirational talk to 125 students from Cummins Engineering College, Pune who visited NARI in March 2024.

10. Dr. Chanda Nimbkar was interviewed by a "Rukhamabai initiatives" fellow with the information on her life and career being posted on their website. This initiative launched in 2020 works towards recognizing and improving the presence of Indian women in STEM.

I congratulate Dr. Anil Rajvanshi and Dr. Chanda Nimbkar for their dedicated work and achievements during the year.

We are extremely grateful for the generous donation to our corpus by Dr. Stuart Winter (Rs. 1,00,940). He had also donated a similar amount in F.Y. 2021-22. Such monetary donations from many well-wishers of the Institute make it possible for us to continue our research and development work.

Dr. Nandini Nimbkar

September 2024.

Agriculture and Energy Research

Agriculture Report 2023-24 (Highlights)

Highlights of Agricultural Research:

Overall, the crops were good this year. Though the rainfall was deficient canal water availability for irrigation was satisfactory.

As has been found during the past many years, applying organic fertilizer did not show any desirable outcomes to justify their high cost.

Safflower germplasm trial conducted for Delhi University showed wide variation among the entries for various characters including seed weight per plant and 100 seed weight. Though attack of wilt (*Fusarium oxysporum*) did decimate some entries, it wasn't severe enough to vitiate the trial as in the past.

The semi-automatic syrup plant developed during the DST-funded project was successfully operated to prepare sweet sorghum syrup and sugarcane jaggery throughout the year. None of the germplasm entries evaluated were found to give significantly superior performance to the control entries hybrid Madhura-1 and varieties Madhura-2 and -3.

Details of the trial conducted were:

Trial 1 : Effect of spraying Gibberellic acid on wheat (*Triticum aestivum*)

In literature it has been reported that the seed number, 1000 seed weight and grain yield are significantly enhanced by spraying Gibberellic acid (GA) at 100 ppm concentration on wheat at anthesis. When we tried this out on wheat crop at NARI, a slight increase in grain yield was observed in GA-sprayed plots over unsprayed plots (Tables 1 and 2). It has been reported that maximum effect of GA spraying is observed when the crop is under water-deficit conditions. Since our crop was irrigated four times during the season it had no moisture stress, which could have been the reason for the non-significant response to GA.

Trial 2 : Trial to compare the performance of safflower (*Carthamus tinctorius*) germ plasm lines from the University of Delhi (details are in the report).

In this trial 117 entries were evaluated (Table 3). Seed yield per plant and 100 seed weight were recorded from three plants per plot (Table 4). Also

recorded were number of plants per plot 18 days after sowing, days to 50% flowering and flower colour at anthesis and maturity. The highest average seed yield per plant was 48.7 g/plant and the lowest 0.11 g/plant. The highest average 100 seed weight was 5.9 g and the lowest 0.7 g.

The most promising entries were as follows :

Sr, No.	Entry	Average seed yield per plant (g)	Average 100 seed weight (g)	No. of plants/plot	Days to 50% flowering	Flower colour
1	2(7) 1047	48.7	4.6	35	74	Y-R
2	2(7) 841	44.6	3.8	1	74	Y-R
3	2(7) 869	44.5	5.5	2	82	Y-R
4	2(7) 699	42.7	5.1	25	68	Y-R
5	2(7) 993	38.3	2.7	13	72	Y-Y
6	2(7) 1838	14.4	5.9	23	74	Y-Y

Unfortunately, entries 2(7) 841 and 2(7) 869 had very poor germination with only 1 and 2 plants per plot respectively. Among the promising entries 2(7) 699 had the earliest maturity and 2(7) 869 the latest. Four of the promising entries had yellow flowers at anthesis turning red on maturity and two of the entries had flowers that remained yellow throughout.

Trial 3: Comparison of organic and inorganic fertilizer application on sugarcane (*Saccharum officinarum*)

In the year 2021-22 trials were taken with biofertilizers provided by Bomlife Pvt. Ltd., Kolkata on soybean, sweet sorghum, sunflower and sugarcane. No advantage of biofertilizer application over that of inorganic fertilizer application was observed in soybean, sweet sorghum and sunflower, as reported in last year's annual report.

The information about the sugarcane trial is given below:

Variety	Co-86032
Date of ratoon	27/2/2023
Application of Bomlife bio fertilizer @ 75 kg/hectare (mixing with compost in 1 (Bomlife) : 5 (compost) proportion	6/4/2023
Herbicide spraying	26/4/2023
Earthing up operation	15/6/2023
Weeding	17/6/2023
Date of observation recording	6/4/2024

Since the fertilizer application to the sugarcane was already carried out when the Bomlife biofertilizer trial was initiated, the comparison was between the plots that received inorganic + organic fertilizer and only

inorganic fertilizer. The plots receiving only inorganic fertilizer gave slightly higher number of internodes, stem diameter and brix of juice, while those receiving a combination of organic + inorganic gave slightly higher biomass (Table 5). However, there was no significant advantage in using the organic fertilizer as its cost is quite high.

The trial was repeated to compare the only inorganic fertilizer treatment with the only organic fertilizer one. The quantity and mode of application of fertilizers was the same as in the earlier trial. Here also the treatment of only inorganic fertilizer application gave greater plant height, cane yield and jaggery weight (Table 6). The crop receiving only organic fertilizer gave slightly higher brix of juice and scum weight during jaggery production.

Trial 4 : Evaluation of sweet-stalked sorghum [*Sorghum bicolor* (L.) Moench] Kharif 2023 and Rabi 2023-24 seasons

Overall, the performance of sweet sorghum station germ plasm lines was better during Kharif season than during the Rabi though the final plant stand was only half that in Rabi (Table 7). Madhura-1, the sweet sorghum hybrid was the entry which had nearly the same highest final plant stand in both the seasons. No grain production was observed during the Kharif due to the heavy rainfall received during anthesis, while during Rabi the average seed production was 1.6 MT/ha (Table 8). Plant height and stem diameter were also about 1.3 times greater in Kharif than in Rabi. This along with three times greater stripped stalk weight, 1.6 times greater juice extraction percentage, no seed production and half the stem borer damage in Kharif resulted in more than four times greater juice weight than in Rabi. Surprisingly despite the fairly good seed production average juice brix in Rabi was comparable to that in Kharif (Table 9).

Trial 5 : Multiplication of 31 germplasm lines, 20 land races and three controls of sweet sorghum was carried out during Rabi 2023-24. The seed produced ranged from 70 to 1361 g/entry.

Scientists: Dr. Nandini Nimbkar, Mr. Sharad Choudhari

Technical assistants: Ms. Anita Gholap, Mr. Maruti Shirke

The detailed report with tables and data is given here.

Weather Data for Phaltan (2023-24)

Energy Research

Title: Developing low-cost drinking water technology for rural schools.

Funded by: Tata Sons Ltd. Mumbai (Tata Business Excellence Group)

Project duration: 2.0 years (March 2023 to March 2025)

Objectives

1. Development of an easy-to-use drinking water technology (DWT) unit based on rainwater harvesting (RWH) and solar water purification (SWP) at the Nimbkar Agricultural Research Institute (NARI).
2. Making the DWT unit ready for installation in rural schools by making it fool-proof, robust and safe to be used by children, while keeping it modular and economically viable.
3. Installing the DWT unit in a rural school in Phaltan region.
4. Training students on water testing and DWT unit maintenance by developing an instruction module, and explaining the underlying science.
5. Popularizing DWT through videos, reports, and electronic media.

Highlights of the work done and achievements:

1. Development of an easy-to-use drinking water technology (DWT) unit based on rainwater harvesting (RWH) and solar water purification (SWP).

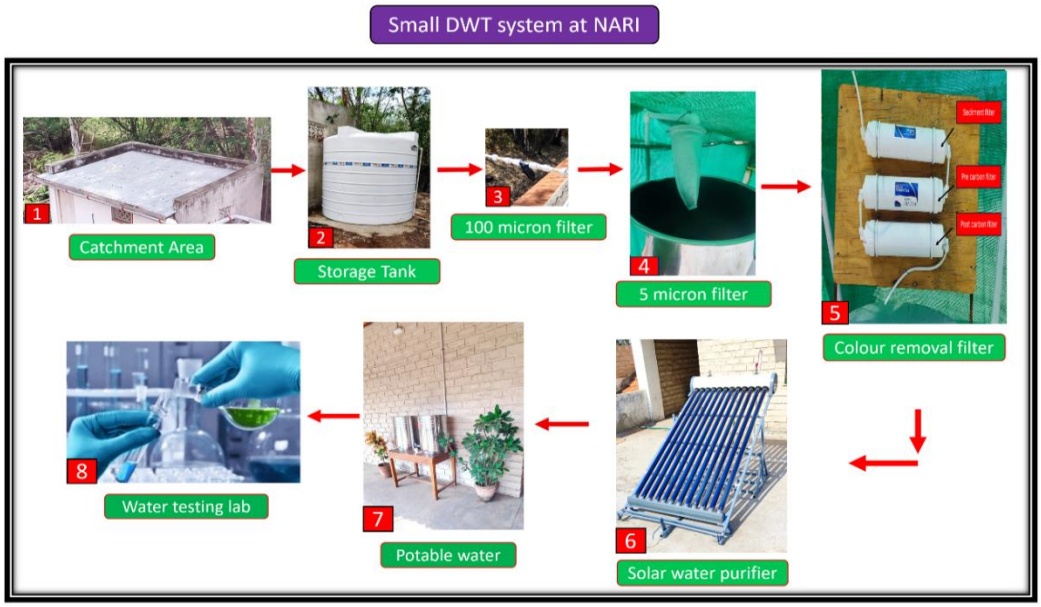


Fig. 1. Small DWT system at NARI.

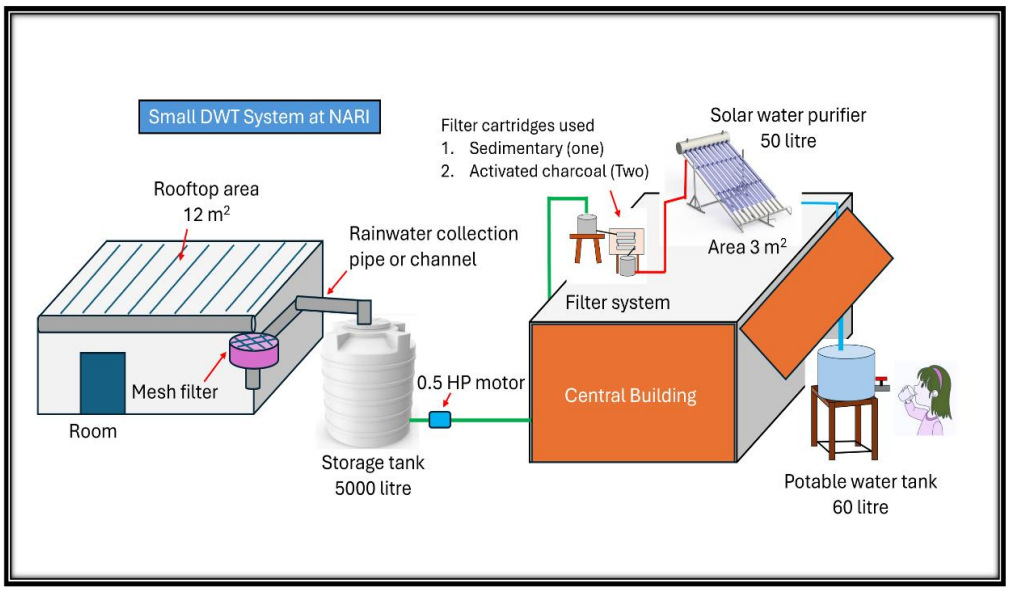


Fig.2.Schematic diagram of Small DWT system at NARI.

2. After the successful development of a small DWT system at the institute, we fabricated and installed a larger unit at Adarki Madhyamik School, (Adarki) Phaltan.

3. Training sessions were organized for the students on the operation and maintenance of the DWT unit

9th class female students with Aditi Nalawade.

4. Training sessions were organized for the teachers also on the operation and maintenance of the DWT unit.

School teachers with Aditi Nalawade and Manoj Kumar.

5. Students drink pure water.

Details of Drinking Water Technology system

Between April 2023 and March 2024, the Nimbkar Agricultural Research Institute (NARI) undertook a research and development project aimed at scaling up the existing drinking water technology (DWT) system to provide potable water to rural schools. DWT combines Rainwater Harvesting (RWH) with Solar Water Purification (SWP).

The earlier DWT system was capable of processing 20 litres of water per day, as described in the research paper "Low-Cost Drinking Water Technology: Rainwater Harvesting with Solar Purification" by Shivam Patange, Nandini Nimbkar and Anil K. Rajvanshi. Building on the successful testing of the 20-litre model, we scaled up the design to a 56-litre SWP unit. This system effectively eliminates microbial contaminants, including coliforms, by heating water to greater than 60 ^{o}C, ensuring its drinking safety.

The IIT Kanpur water test kit is more affordable than others on the market. The sample from the SWP unit is incubated in the large tube provided in the kit for 20 hours. After that, it is transferred to the smaller tube and incubated for another 4 hours. If the solution turns dark pink, it indicates microbial contamination in the water which requires treatment. If it remains colourless, the water is safe to drink.

In April 2024 we initiated a survey of local schools to identify a suitable site for installing a 200-liter-per-day DWT unit.

During our survey, we visited about 10 schools in the Phaltan area and evaluated them to decide whether we can successfully install the DWT in them. The selection criteria included: a maximum of 200 students (Adarki School has 191 students), students in grades five through ten to be involved in operating the RWH system with the SWP unit, a demonstrated need for pure drinking water, and a flat rooftop suitable for installing the DWT unit.

Adarki School was selected for this project as it met all these criteria.

A legal agreement between Adarki School and NARI included NARI installing rainwater harvesting system with solar purifier units, with the school providing space for the installation and ensuring full cooperation for the project. The school is responsible for maintenance, with the principal accountable for any damage or theft.

In June 2024, we successfully installed the Drinking Water Technology (DWT) system, equipped with a Solar Water Purifier (SWP), at Adarki School in Phaltan. Subsequently, in July 2024, we conducted training sessions for both students and teachers to ensure that they were proficient in operating the system independently.

A second school in Nandal village (12 km from Phaltan) has been identified and we hope to put the second unit in it by October 2024.

- People involved: Dr Anil K Rajvanshi, Ms Aditi Nalawade, Mr Manoj Kumar, Mr S.V. Choudhari, Mr S. Adsul.

The detailed report is available here.

Animal Husbandry Research

Highlights (2023-24)

In the past year, the Animal Husbandry Division (AHD) of NARI has made significant strides across various projects.

Under Project I, the Osmanabadi Goat Field Unit, funded by ICAR, goat performance was evaluated across five districts, leading to improved management practices and productivity. This effort has resulted in an increased proportion of true-to-type Osmanabadi goats, reduced mortality rates, and higher incomes for goat keepers. Over 58,000 straws of Osmanabadi buck semen were produced, achieving conception rates of 50-55%.

Project II focused on the NARI Suwarna Sheep, where the breeding program continued to enhance genetic diversity and lamb production through Artificial Insemination (AI). The program's success is being disseminated to farmers in Maharashtra, Karnataka, Telangana, and Andhra Pradesh.

Project III, the AI Center for Sheep and Goats, established in 2012, has maintained its role as a crucial resource, producing high-quality frozen semen straws and achieving around 50% conception rates. This centre has significantly boosted local goat productivity through its AI services.

Project IV, on veterinary parasitology, involved monitoring faecal worm egg counts and FAMACHA scores to manage gastro-intestinal nematodes in sheep and goats. Closantel, an effective anthelmintic for *Haemonchus*

contortus, was used to control parasitic infections, demonstrating effectiveness for up to 42 days.

In terms of training, two refresher courses were conducted in March 2024 for Pashusakhis from Manndeshi Foundation, covering goat health, nutrition, reproduction, sustainable parasite control, and AI. These courses were attended by participants from various districts, including Satara, Latur, Nasik, Kolhapur, and Solapur.

Additional highlights include a four-day entrepreneurship training organized in August 2023 for students from Guru Angad Dev Veterinary and Animal Science University, which included practical field visits. On December 12, 2023, a training session was held at the Wadjal office for goat keepers and extension workers of the Osmanabadi goat project. Community engagement was further enhanced with display boards in Morochi and Gosaviwadi villages, leading to increased local participation in projects. The animal husbandry division continues to inspire and lead in practical, data-driven research and technology transfer.

The Detailed AHD report is given here

Annual Fact Sheet

Publications

- 15 articles in magazines and newspapers
- 2 conference papers
- 1 report
- 7 op-eds
- 5 podcasts
- 6 videos
- 1 blog post
- 1 booklet
- 1 book
- 1 audiobook

Visitors to NARI

- 11 professors from Prestigious Educational Institutions
- 125 students from Cummins College
- 206 students, goat and sheep keepers and farmers.

Total sales

- 4928 buck semen straws supplied in bulk
- 96 NARI Suwarna sheep disseminated for breeding
- 1879 kg food products (Sweet sorghum syrup/Jaggery/Safflower oil/Mustard oil/Safflower herbal tea/Sugarcane syrup)
- 378 kg seeds of different varieties of sweet sorghum, safflower, *Leucaena, Stylosanthes, and Desmanthus*
- 10.8 Metric Tons (MT) of foodgrains and oilseeds (wheat, soybean, sorghum, safflower, pearl millet) sold
- 35 MT of sorghum fodder
- ~40 MT of firewood
- 662 Eucalyptus poles
- 162 MT of sugarcane

Governing Council (2023-2026)

Governing Council

- Dr. Nandini Nimbkar, Ph.D., Permanent President, NARI
- Dr. Chanda Nimbkar, Ph.D., Director, Animal Husbandry Division, NARI
- Dr. Noorie Rajvanshi, Ph.D., Environmental Sustainability Leader (Global Operations), Hewlett Packard Enterprise, USA
- Ms. Madhura Rajvanshi, MA, Trustee, Pragat Shikshan Sanstha, Phaltan
- Mr. S. K. Jha, I.R.S., Retired Chief Commissioner of Income Tax, Pune
- Professor P. Balaram, Padma Bhushan Awardee, Ph.D., Former Director, Indian Institute of Science, Bangalore
- Dr. Anil K. Rajvanshi, Padma Shri Awardee, Ph.D., Director and Hon. Secretary, NARI

TRUSTEES

- Dr. Nandini Nimbkar, Ph.D., Permanent President, NARI
- Dr. Chanda Nimbkar, Ph.D., Director, Animal Husbandry Division, NARI
- Dr. Anil K. Rajvanshi, Ph.D., Director and Hon. Secretary, NARI
- Dr. Noorie Rajvanshi, Ph.D., Environmental Sustainability Leader in Global Operations, Hewlett Packard Enterprise, USA
- Dr. Manjiri Nimbkar, M.B.B.S., Director, Pragat Shikshan Sanstha, Phaltan
- Ms. Madhura Rajvanshi, MA, Trustee, Pragat Shikshan Sanstha, Phaltan
- Dr. Priyadarshini Karve, Ph. D., Director, Samuchit Enviro Tech, Pune