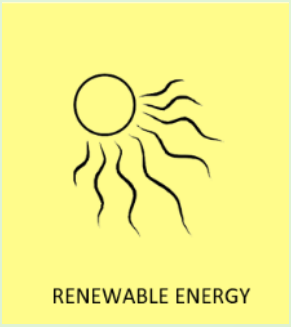
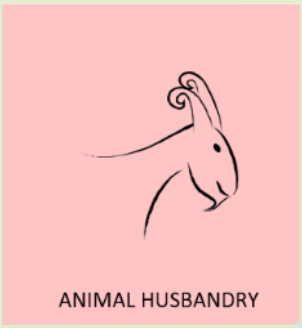
Annual Research Report
(2022-23)





NARI

Nimbkar Agricultural Research Institute
Lonand Road, Phaltan, Maharashtra

Report of the President

I have the pleasure of presenting to you the NARI annual research report for 2022-23. Some significant events of this year were as follows:

We are proud to report that Dr. Anil Rajvanshi, the Director of NARI was given the Distinguished Alumnus Award of IIT Kanpur in November 2022. Besides he was also named as one of the legends of IIT Kanpur.

The Padma Shri given to Dr. Rajvanshi last year has helped the Institute to get wide coverage nationally. He was therefore invited by many organizations across the country to give keynote and chief guest lectures.

The first death anniversary of the late Shri B.V. Nimbkar, the founder of NARI, was on 25 August 2022. A public event was organized by his family in Phaltan on 11 September 2022. The details are here.

A short biography of Dr. Chanda Nimbkar, the Director of Nimbkar Agricultural Research Institute, Animal Husbandry Division was included in the book 'Vigyan Vidushi' published by Vigyan Prasar, DST, Government of India. Dr. Chanda Nimbkar was also honoured with the 'STREE 2020' national award on 26 March 2023 in Pune by the organization Sharada Shakti (Western Maharashtra). I congratulate her for receiving these accolades.

We gratefully acknowledge the donation of Rs. 3000 by Mr. Amod Inamdar for research in our animal husbandry division. Also, during the past year Rs. 2,50,000 were donated by Dr. Anil Rajvanshi and Rs. 3,50,000 by Dr. Nandini Nimbkar. All these donations make it possible for us to continue our research and development work.

We thank Tata Sons Pvt. Ltd. for agreeing to finance over a period of two years the research and development towards the purpose of helping the marginalised community of rural school children by providing them with clean drinking water.

N. Nimbkar

Dr. Nandini Nimbkar

August 25, 2023.

President

Contents

Agriculture and Energy Research

Sweet sorghum Syrup Project

Title: Development of a fully mechanized plant to produce syrup from sweet sorghum

Funded by: Department of Science and Technology (DST), Government of India

Project duration: 2.5 years (September 2020 to February 2023)

Executive summary of the project

A video showing the process of syrup making

Highlights of the work done and achievements:

1. Development of an efficient and environment-friendly 300-400 kW (thermal) multi-fuel biomass furnace with 20-25% efficiency.

2. Fuel self-sufficient furnace

3. Production of 150-210 kg sweet sorghum syrup of 74–76 degree brix in 24 hours (50-70 kg per batch).

4. Less human intervention, improved safety of workers and reduction in syrup losses

Details of Sweet sorghum crop used for syrup production.

A total of 22 batches of syrup was made from sweet sorghum juice in the year 2022-23. They were made from the juice of Madhura 3 (10 batches), Madhura 2 (2 batches), mixture of juice of Madhura 1 and 2 (1 batch), mixture of juice of Madhura 1 and 3 (2 batches) and mixture of juice of Madhura 1, 2 and 3 (7 batches). The dates of sowing were from 14 December 2021 to 21 December 2022. The age of the crop when harvested ranged from 88 to 145 days. Average 57 Kg syrup was made per batch (Range: 3.6 – 89.0 Kg).

The highest biomass weight of 47.7 T ha^{-1} was recorded for Madhura 3 sown on 9 March 2022 and harvested on 6 July 2022 (119 days). This was followed by a mixture of Madhura 1 and 2 also sown on 9 March 2022 and harvested on 21 June 2022 (104 days), which gave 42.3 T biomass ha^{-1}. These also gave the highest stripped stalk yield (after removing damaged stalk) exceeding 20 T ha^{-1}. The lowest stem borer (*Chilo partellus*) damage was recorded when sowing was carried out in

the months of September and December. Highest amount of juice production (9.75 T ha^{-1}) was recorded in March-planted crop harvested in July (119 days). Highest juice brix of 23 was recorded in December-planted crop harvested in April (126 days) and February-planted crop harvested in May (118 days). Highest stripping % of 63 was recorded in September-planted crop harvested in January (mainly due to low stem borer damage). See Table 1.

Highest juice extraction (~ 50%) on stripped stalk basis was observed in July-planted crop harvested in November or September-planted crop harvested in January. Highest amount of syrup produced (3.6 T ha^{-1}) was from December-planted crop harvested in April (126 days). Highest syrup recovery (on juice basis) exceeding 28% was recorded in December-planted crop harvested in April (126 days) and February-planted crop harvested in May (118 days). See Table 1.

March-planted crop harvested in July (119 days) gave the highest leaf weight of nearly 14 T ha^{-1}. Highest amount of scum of 15% was produced in June-planted crop harvested in September (115 days). June-planted crop harvested in September (88 days) gave the tallest plants with an average height of 330 cm, while greatest stem diameter of 2.34 cm was recorded in March-planted crop harvested in July (119 days). See Table 2.

Highest syrup yield per unit area was obtained when sowing was carried out either in December or February and when the crop was harvested at grain maturity. For these sowing dates the juice brix was the highest and stem borer damage low (< 5%).

March-planted crop harvested in June or July gave the highest stem diameter, leaf production and yield of biomass, stripped stalks, and juice.

Therefore, months of December through March appear to be most suitable for sowing sweet sorghum for syrup production.

- Scientists (Alphabetically): Ms. Rezeena Chinthamalla (Intern), Mr. S.V. Choudhari (Assistant director and Farm manager), Mr. Rivan Jadav (Intern), Mr. S.D. Patange (Research engineer), Dr. Anil K Rajvanshi and Dr. Sankalp Tiwari (Research fellow).

- Technical assistants (Alphabetically): Mr. S. A. Adsul, Ms. A. R. Gholap, Ms. S.A. Khalate and Mr. M. G. Shirke.

Madhura-3 Mature crop

Madhura-3 Young crop

Soil Analysis

A portable, handheld, lightweight, smart device called “Bhu-Parikshak” has been developed for determination of soil nutrients by Dr. Jayant Kumar Singh and his colleagues of Department of Chemical Engineering at IIT Kanpur. He was kind enough to give it to NARI for testing.

Indian farmers are known for their excessive use of fertilizers such as urea. They generally do not get their soil analysed to determine the correct quantity of fertilizer to be applied, one of the reasons being the delay in report delivery of a month or more. Also, the conventional soil analysis uses a lot of chemicals. Therefore, this device was developed which is claimed to have the following features:

1) Chemical-free, 2) Less time-consuming, 3) Accurate (Relative error being ~ 20%), 4) Reliable, 5) Stores data for recommendation of optimum fertilizer application, 6) Low power consumption, 7) Android support, 8) Multiple parameters determined simultaneously, 9) No sample preparation required and 10) Instant results.

Comparison of readings obtained using Bhu-Parikshak with those from analysis done at the Krishi Vigyan Kendra (KVK), Baramati of soil samples from seven different plots at Tambmal farm, NARI (January 2023).

1. Nitrogen (Kg/ha): Bhu-Parikshak on an average gave 29% (Range +11.3 to -92.9) lower values than KVK laboratory analysis. All the values were characterized as low, while in KVK analysis four values were designated as low and three as medium.

2. Organic Carbon (%): Bhu-Parikshak on an average gave 7.6% (Range +42 to -50.4) higher values than KVK analysis. All the values were characterized as high, while in KVK analysis one value was designated as medium, two as high and four as very high.

3. Potassium (Kg/ha): Bhu-Parikshak gave 198.7% (Range -133.4 to –303.3) lower values than KVK analysis. All the values were characterized as medium, while in KVK analysis all were designated as very high.

4. Phosphorus (Kg/ha): Bhu-Parikshak gave 69.8% (Range 50.5 to 82.8) higher values than KVK analysis. All the values were characterized as high, while in KVK analysis one value was designated as very low, four as low and two as medium.

5. Cation Exchange Capacity (meq/100 g): Bhu-Parikshak gave values ranging from 5.18 to 6.7 and all were designated as moderate. KVK analysis did not report this parameter.

6. Bhu-Parikshak designated one sample as loam (10.45% clay) and six samples as fine sandy loam (Range 6.21 to 8.25% clay).

Comparison of Soil analysis data recorded by Bhu-Parikshak with that from KVK Baramati (Same soil samples)

	Nitrogen (Kg/ha)						
	Plot-2	Plot-7	Plot-8	Plot-9A	Plot-9B	Plot-9C	Plot-10
Bhu-parikshak	175.98	203.46	190.25	212.06	215.05	209.74	198.7
Lab test	156	260	233	409	289	281	204

	Organic carbon (%)						
	Plot-2	Plot-7	Plot-8	Plot-9A	Plot-9B	Plot-9C	Plot-10
Bhu-parikshak	1.12	1.21	1.32	1.13	1.17	1.13	1.23
Lab test	0.65	1.08	0.97	1.7	1.2	1.17	0.85

	Potassium (Kg/ha)						
	Plot-2	Plot-7	Plot-8	Plot-9A	Plot-9B	Plot-9C	Plot-10
Bhu-parikshak	201.1	164.83	191.08	170.07	155.26	166.65	180.66
Lab test	811	436	446	402	536	452	609

	Phosphorus (Kg/ha)						
	Plot-2	Plot-7	Plot-8	Plot-9A	Plot-9B	Plot-9C	Plot-10
Bhu-parikshak	15.9	37.97	29.51	64.12	71.02	55.43	50.54
Lab test	6.18	13.26	14.6	16.21	12.18	12.72	11.64

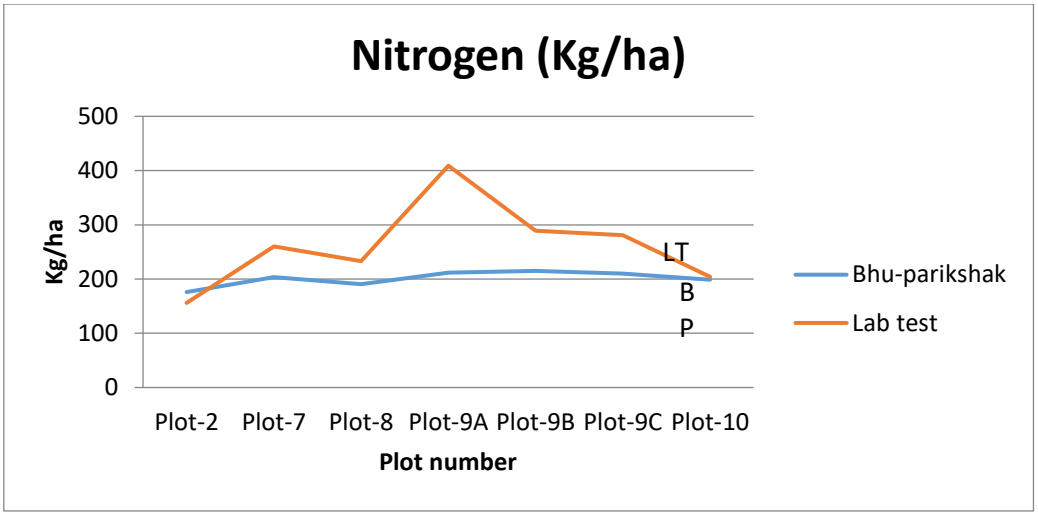
	Cation Exchange Capacity (meq/100 g)						
	Plot-2	Plot-7	Plot-8	Plot-9A	Plot-9B	Plot-9C	Plot-10
Bhu-parikshak	6.7	5.49	6.37	5.67	5.18	5.56	6.02
Lab test	Not measured						

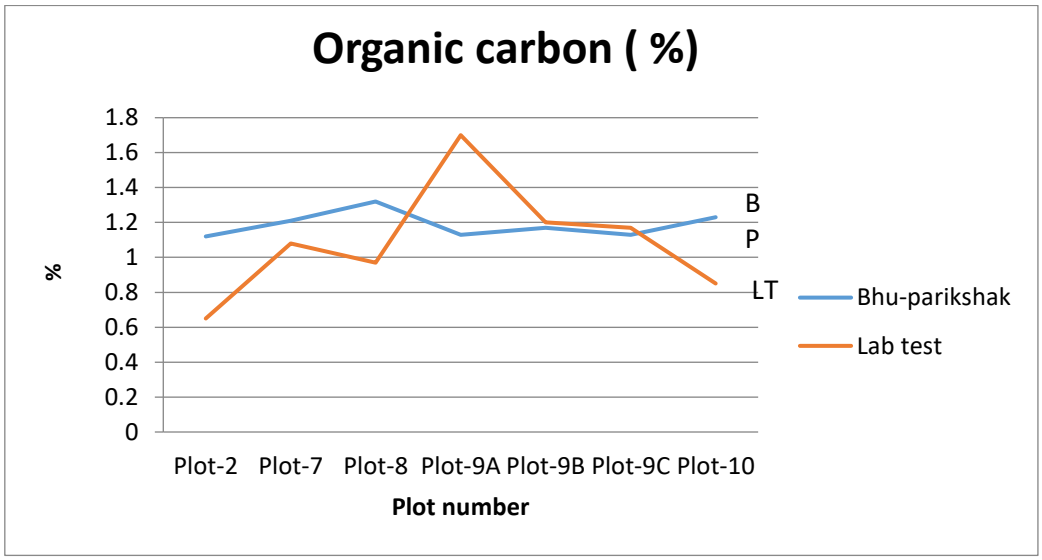
Type of soil		**% Clay**
Plot-2	loam	10.45
Plot-9C	fine sandy loam	7.25
Plot-8	fine sandy loam	8.25
Plot-9A	fine sandy loam	7.48
Plot-7	fine sandy loam	6.68
Plot-9C	fine sandy loam	7.25
Plot-9B	fine sandy loam	6.21
Plot-10	fine sandy loam	7.86

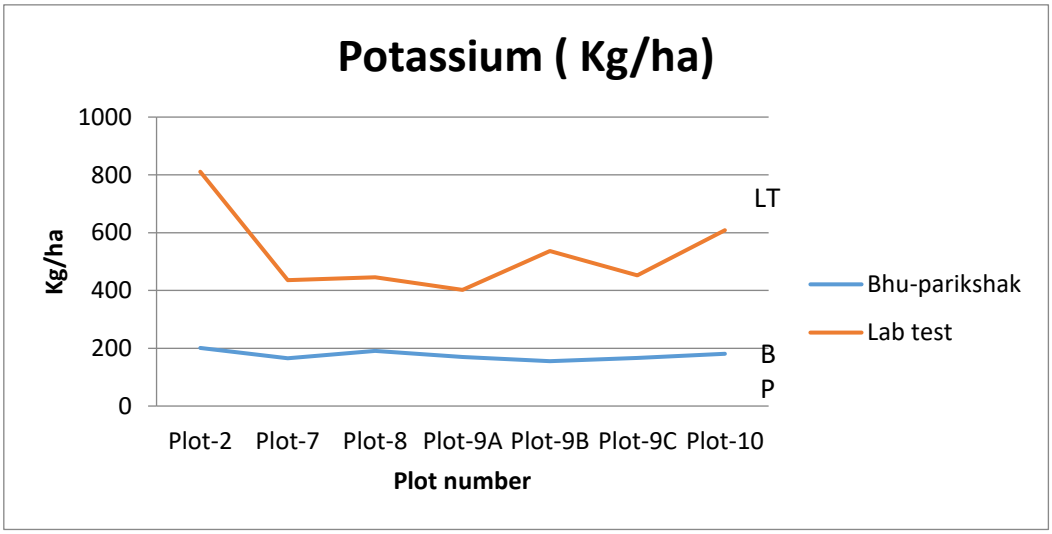
Conclusion: Compared to the laboratory test Bhu-Parikshak gave higher readings of Phosphorus and lower readings of Nitrogen and Potassium and mixed readings of Organic Carbon.

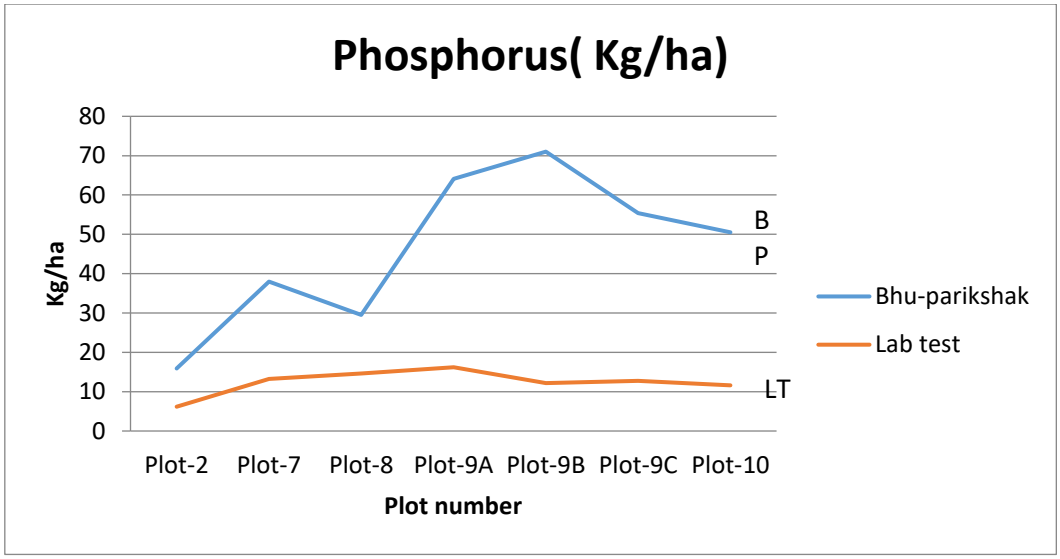
Scientists: Dr. Nandini Nimbkar, Mr. S. V. Choudhari, Mr. V. S. Nigade (Agronomist)

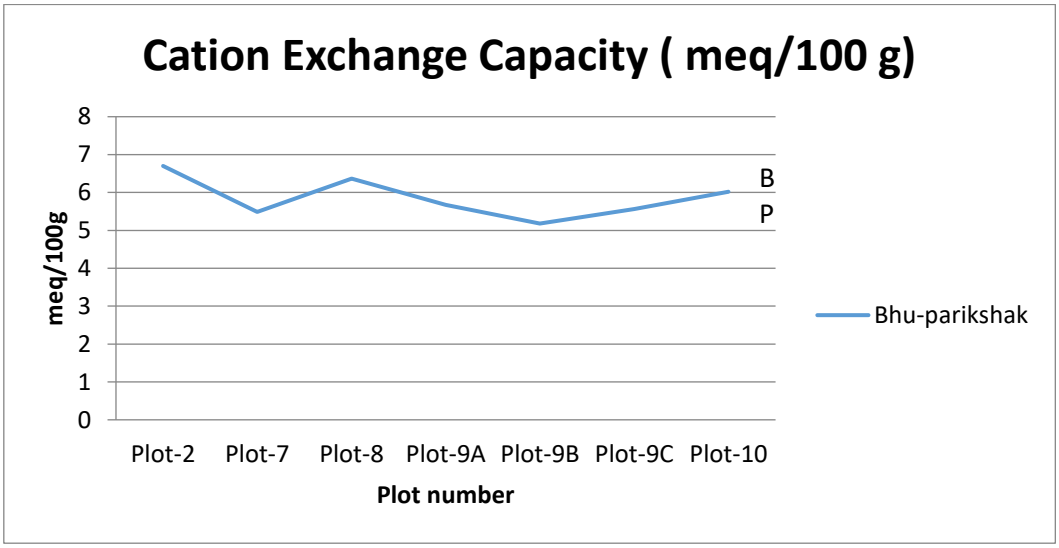
Technical assistants: Ms. A. R. Gholap, Mr. M. G. Shirke


Nitrogen (Kg/ha)
500
400
300
200
100
0
Kg/ha
LT
B
P
Plot-2 Plot-7 Plot-8 Plot-9A Plot-9B Plot-9C Plot-10
Plot number
Bhu-parikshak
Lab test


Organic carbon (%)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
%
B
P
LT
Plot-2 Plot-7 Plot-8 Plot-9A Plot-9B Plot-9C Plot-10
Plot number
Bhu-parikshak
Lab test


Potassium (Kg/ha)
1000
800
600
400
200
0
Kg/ha
LT
B
P
Plot-2 Plot-7 Plot-8 Plot-9A Plot-9B Plot-9C Plot-10
Plot number
Bhu-parikshak
Lab test


Phosphorus(Kg/ha)
Kg/ha
80
70
60
50
40
30
20
10
0
B
P
LT
Plot-2
Plot-7
Plot-8
Plot-9A
Plot-9B
Plot-9C
Plot-10
Plot number
Bhu-parikshak
Lab test


Cation Exchange Capacity (meq/100 g)
meq/100g
8
7
6
5
4
3
2
1
0
B
P
Plot-2
Plot-7
Plot-8
Plot-9A
Plot-9B
Plot-9C
Plot-10
Plot number
Bhu-parikshak

Weather Data

Weather data of 2022-23 (April 2022 to March 2023) was recorded at NARI Head Office, Tambmal.

During this year, the highest maximum temperature of 44.5^{0}C was recorded on 28 April 2022. The lowest minimum temperature of 10^{0}C was recorded on 11 January 2023. The highest one-day rainfall of 71.5 mm was recorded on 18 October 2022.

Other Activities

NARI's Bajaj Centre for Sustainable Development was utilized by Pragat Shikshan Sanstha for the two contact sessions (11-15 April and 27-30 July 2022) of 'Pustak Maitri Abhyaskram- a short professional development course in Marathi for individuals like teachers, librarians and anganwadi workers who work with books and children. 25 participants from 11 different organizations in Maharashtra joined this course.

Animal Husbandry Research

Highlights

The first death anniversary of the late Shri B.V. Nimbkar, the founder of NARI, was on 25 August 2022. A public event was held by his family and the NARI AHD on 11 September 2022 at the Maharaja Mangal Karyalay, Phaltan to commemorate his pioneering work in agriculture and animal husbandry. Hon'ble Shri. Ramraje Naik Nimbalkar, chairman of the governing council of the Maharashtra Goat and Sheep Research and Development Institute presided over the event.

The introductory speech was made by Shri Arvind Mehta, well-respected reporter from Phaltan and a friend of Shri Nimbkar's. Dr. Chanda Nimbkar and Ms. Madhura Rajvanshi gave a narrated slide show based on the major events in Shri Nimbkar's life and his achievements. Dr. Anand Karve and Shri. Vijay Kolte then gave lectures on Shri Nimbkar's work in the fields of agriculture and animal husbandry respectively. Dr. Nandini Nimbkar gave a speech expressing the Nimbkar family's gratitude to all the people of Phaltan and other places who cooperated with Shri Nimbkar in his work throughout his life. A vote of thanks was given at the end by Ms. Madhura Rajvanshi. Shri Rajendra Pawar of the Agricultural Development Trust, Baramati and Shri Raghunathraje Nimbalkar were among the many friends and associates of Shri Nimbkar who were present at the event.

The Senior Veterinarians' Foundation (Jyeshtha Pashuvaidya Pratishthan) Maharashtra, Pune annually gives awards to outstanding livestock breeders and veterinarians. Shri Vasantrao Jahagirdar, a trustee of the Maharashtra Goat and Sheep Research and Development Institute and a close associate of the late Shri B.V. Nimbkar and the Nimbkar family gave a donation to the Pratishthan to institute **two new awards from 2022, one for an 'outstanding goat breeder' and one for an 'outstanding sheep breeder' in the name of the late Shri B.V. Nimbkar** (Padmashri awardee in 2006). Eligible goat and sheep breeders had to apply for this award. The two candidates selected by the Pratishthan for these awards were Shri Bapu Dilip Keskar, of Rajale, Tal. Phaltan (outstanding goat breeder) and Shri Bandopant Balu Haral of Khupire, Karveer, Dist. Kolhapur (outstanding sheep

breeder). They received the awards in a function in Pune on 29 May 2022. Shri Keskar has been rearing Boer goats under a stall-feeding system for the past twelve years while Shri Haral has been rearing Nari Suwarna and Deccani sheep for eight years successfully in the high rainfall area of Karveer.

- A short biography of **Dr. Chanda Nimbkar, the Director of Nimbkar Agricultural Research Institute, Animal Husbandry Division was included in the book Vigyan Vidushi** published by Vigyan Prasar, an autonomous organization under the **Department of Science and Technology, Government of India**. The book portrays the contribution to science of 75 Indian women scientists and was published on the occasion of 75 years of Indian Independence.

- Dr. Chanda Nimbkar was honoured with the 'STREE 2020' national award on 26 March 2023 in a function at the Lady Ramabai Hall at S.P. College in Pune by the organization Sharada Shakti (Western Maharashtra) which works for the empowerment of women through science and technology.

- On 6-16 June 2022, Dr. Pradip Ghalsasi, Associate Director, AHD, NARI was invited by "Feed the Future Knowledge-based Integrated Sustainable Agriculture in Nepal (KISAN II)" to conduct a training course on "Artificial Insemination in Goat: extraction, processing, storage and transport of frozen buck semen". He also visited National Livestock Breeding Organizations (NLBO) in different provinces of Nepal to observe the process of buck semen collection, processing, storage and supply carried out by them and guide them to improve their operations. KISAN II has partnered with the Nepal government Department of Livestock Services (DLS) and conducted multiple training courses on artificial insemination in goats for technicians, imported frozen Boer goat semen from USA and is in the process of supporting NLBOs to strengthen their production and supply of quality Boer semen. Dr. Pradip Ghalsasi and his team members Mrs. Padmaja Ghalsasi and Mr. Rupsing Khanvilkar carried out the training program and related tasks successfully.

  Overall, all the participants including the Director General of the DLS and other government officials were highly impressed with NARI's team, the training sessions and support to improve the operations of the NLBO laboratories in Banke and Pokhara.

- It is a great achievement of NARI AHD that the Nari Suwarna sheep breed developed by the AHD has begun to spread in Karnataka widely. The Karnataka government has now approved the establishment of a Nari Suwarna breeding centre and sanctioned Rs.1 crore funds to establish it. A place has been selected in Kopal district for the proposed breeding centre. Mr. Mahesh Mirajkar of Belgavi has established a farm with 100 NARI Suwarna homozygous ewes and is planning to start a North Karnataka NARI Suwarna Breeders' Association.

- NARI-AHD bought a new 'straw filling and sealing machine (MRS-1 Dual V2)' with its standard accessories (IMV Technologies), worth Rs.23,62,500/- for its frozen semen laboratory.

- For the first time since the establishment of the frozen semen laboratory at NARI, AHD in 2012, the laboratory staff at AHD carried out the complete procedure of freezing of buck semen in the absence but under the guidance of Dr. Pradip Ghalsasi. This year, **the staff have frozen a total**

of 2781 Boer, 1449 Osmanabadi, 561 Damascus and 63 Awassi ram doses of semen. Dr. Ghalsasi found all the semen doses to be excellent in his evaluation. We applaud the efforts taken by the whole team which includes Shri Kanhaiya Chavan, Ms. Sanyogita Kumbhar, Ms. Karishma Shaikh, Mr. Dattatray Mulik, Mr. Rupsingh Khanvilkar and Mr. Malhari Dhembare.

- On 4 May 2022, Dr. Nandini Nimbkar, President, NARI and some staff members of NARI head office visited NARI-AHD on AHD's invitation to obtain information on the AHD's activities.

- During 2022-23, five staff meetings were held at NARI-AHD. All staff members participated in these meetings chaired by Dr. Chanda Nimbkar and co-chaired by Dr. Pradip Ghalsasi and many issues were discussed for better streamlining of work. Planning was done for continued plentiful fodder availability at AHD's farms and the staff members gave suggestions for better coordination.

The detailed AHD report is given here.

Annual Fact Sheet

Publications

- 2 publications in refereed/non-refereed journals/conferences
- 15 magazine/newspaper/popular articles
- 17 talks delivered.
- 1 report

Visitors to NARI

- 7 dignitaries from national organizations
- 22 student and women-trainee groups

Visits by NARI staff

- 3 invited lectures/talks/webinars attended.
- 3 meetings attended.

Total sales

- 3839 buck semen straws supplied in bulk.
- 115 NARI Suwarna sheep disseminated for breeding.
- 1,753 kg food products (Sweet sorghum syrup/Jaggery/Safflower oil/Mustard oil/Safflower herbal tea/Sugarcane syrup) sold.
- 153 kg seeds of different varieties of sweet sorghum, safflower, *Leucaena, Stylosanthes, Desmanthus and Cenchrus* sold.
- 7840 kg of foodgrains and oilseeds (wheat, soybean, sorghum, safflower, sunflower, sesame, pearl millet) sold.
- 231440 kg of firewood, sugarcane and fodder sold.

Note: Details of publications, visitors, etc. for AHD are listed in their report.

Governing Council (2020-2023)

Nandini Nimbkar, Ph.D., Permanent President, NARI

Anil K. Rajvanshi (Padma Shri Awardee), Ph.D., Director and Hon. Secretary, NARI

Chanda Nimbkar, Ph.D., Director, Animal Husbandry Division, NARI

Noorie Rajvanshi, Ph.D., Director, Sustainability and Climate Strategy, Siemens, USA

Madhura Rajvanshi, M.A., Trustee, Pragat Shikshan Sanstha, Phaltan

S. K. Jha, I.R.S., Retired Chief Commissioner of Income Tax (CCIT), Pune

Niraj Chandra, B.A., Industrialist, Satara