

From poverty to prosperity through diversity orchard

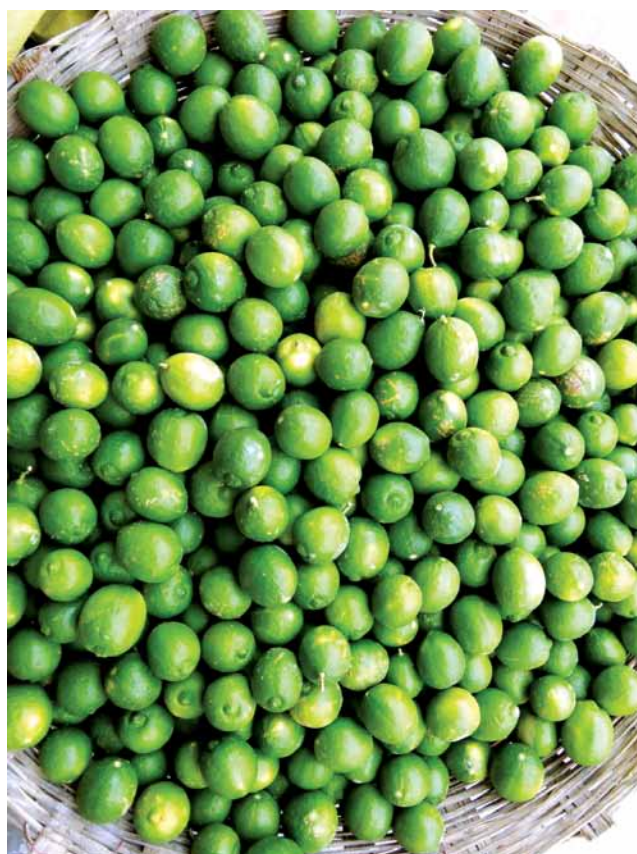
The current study was started in July 2019 at village Malikaur, near Pusa, District Samastipur, Bihar. This region comes under northern part of the state. A farmer was identified for different modules based on his existing production system, potential and interest. The major crops of the region were paddy, wheat, turmeric; elephant foot yam, mango and litchi. The village is 6 km south-west of the Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur and 30 km east of ICAR-NRC on Litchi, Muzaffarpur but the technology awareness and adoption was very low. Most of the farmers were cultivating old varieties and did not have access to quality planting material. The soil being highly fertile and unaffected by flood offered an immense opportunity and potential to make diversity orchard as a profitable enterprise. Through technology transfer and trainings on entrepreneurship skill by ICAR-NRC on Litchi, the farmers have started to diversify their orchard, adopting multi-storeyed cropping, and value added products of mango, litchi, aonla and jamun are available. Inspired by the success of some farmers to grow low chill temperate fruits, the Bihar's horticulture department has decided to launch a pilot project to grow the low chill temperate fruits in seven districts of the state.

AMID government push to increase the dwindling green cover in the country, Bihar's Malikaur village is a standout example of how diversifying the orchard can change things for the better. Mr. Anoj Kumar Rai, B.Sc. (Physics), belonging to village Malikaur, PO Pusa, Samastipur, Bihar had a landholding of 2.20 ha (6 acre) and mostly cultivated area was irrigated. He also owned a diesel pump set, a bore well, 2 portable sprayer and maintained animal resources (2 cow and 1 buffalo).

Before our intervention, he was growing potato, wheat, mustard, rice, red gram, green gram, chickpea etc and some fruit trees (mango and litchi). Although the area where Shri. Anoj Kumar Rai practiced horticulture, is predominantly a horticultural dominant area but sweet orange, mahogany on bund of orchard (as hedge), production of quality guava and papaya, production of low chilling variety of temperate fruits is realized here. Acid lime cv. 'Kagzi nimboo' fetched more prices in market during COVID-19 pandemic. Low chill peach, pear, and plum are the main attraction of his orchard. Guava cv. *VNR Bihi* is found to be the best (yield wise) and paid highest prices so far.

Interaction with ICAR-NRC on Litchi, Muzaffarpur

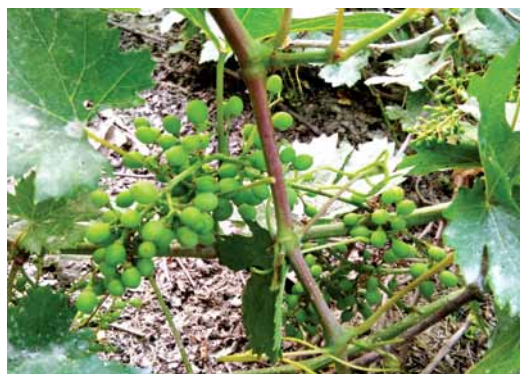
The planting material of improved varieties of litchi was provided for demonstrations by the ICAR-NRC on Litchi, Muzaffarpur, Bihar during 2015. The scientists



Acid lime cv. Sai Sharbati



Apple cv. HRMN 99



Grape cv. Thompson Seedless



Guava cv. VNR Bihi

of ICAR-NRC on Litchi, Muzaffarpur also imparted the training on canopy management, nursery management, wilt management, orchard establishment and processing techniques of seasonal fruits. Shri. Anoj Kumar Rai visited frequently and interacted with scientist of ICAR-NRC on Litchi, Muzaffarpur and procured the planting material of other fruits crops (from many SAUs, ICAR's institutes, private nursery) with the liaising established by scientists of ICAR-NRC on Litchi. He started practicing tools of orchard diversity, intercropping of wheat in sweet orange orchard, canopy management, pruning and training, use of *Trichoderma* for management of fruit borers in litchi and stem borers of mango. Shri. Rai was constantly in touch with scientists of ICAR-NRC on Litchi (Muzaffarpur), ICAR-CISH (Lucknow), ICAR-CCRI (Nagpur), ICAR-NRCP (Solapur) and as a follow up, the scientists of ICAR-NRC on Litchi and ICAR-CCRI visited his orchard regularly. He was provided with all the need based knowledge and skill, including how to control fruit drop and cracking, awareness about varieties of fruit crops suitable for his areas, schedule and dose of fertilizer and integrated pest management techniques.

Imapct

Presently, he grows 32 fruit tree species with 115 commercial varieties of fruit trees (Table 1). Surprisingly, he has established two diversity orchard of mango with 33 varieties. He also followed model of agro-horti-forestry by inclusion of 5 timber species and planted mahogany

trees as hedge to inhibit any trespassing of thief or blue bull menace. He himself prepared 200 grafts of mango every year and established nursery at his own orchard. Recently, he modified propagation methods of acid lime using air layering (instead seed) and raised 500 numbers of gootees which he sold to his neighbour.

In addition to technical guidance from experts of ICAR-NRC on Litchi, RPCAU (Pusa, Samastipur) and State Horticulture department officials, his activeness, sincerity and hard-working nature has contributed in his success. His qualities, and timely technical advice and proper timely implementation has transformed his life which he never thought.

Shri Anoj Kumar Rai is hard working horticulture farmer and able to grasp the technologies faster and adopt it. He is actively involved in all day-to-day working of the orchard and marketing. He can now identify important insect pest of fruit crops, including borers, mites and loopers and their management practices. After seeing the potential of the low chill temperate fruit varieties, Shri. Anoj Kumar Rai also established apple (low chill cultivars) orchard and grapes vineyard. He has adopted and cultivating low chill varieties of pear, peach and plum etc. He has also grafted tomato on brinjal rootstock and it is performing well and produced fruit 2 kg per plant per fruiting season. He is supplying gootees and seedling of acid lime and sweet orange to 50 neighbouring farmers. He also actively guides other farmers in adoption of new technologies. With his intervention they have started to grow different fruit crops in the village and as a result



Intercropping of turmeric in orchard of acid lime



Intercropping of wheat in mosambi orchard



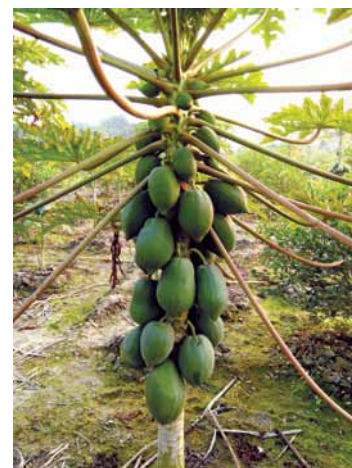
Jamun cv. J-37



Mahogani as hedge in orchard of Papaya, Nimboo



Nagpur Mandarin grown by him



Papaya cv. Pusa Nanha

they are realizing better price in the market.

Use of organic formulations

In case of mango and litchi, he is now using *Trichoderma* (obtained from ICAR-NRC on Litchi, Muzaffarpur) during post monsoon stage. According to him, it is effective in control of wilt and dieback. *Trichoderma* powder is essential for growing /dying tree to apply @ 200 g per tree after mixing in 40 kg FYM (used after mixing and keeping moist overnight).

New varieties being cultivated by him

He has also started growing other improved varieties like litchi (Gandaki Sampada, Gandaki Yogita, Gandaki Lalima), longan (Gandaki longan 1), mango (Arunika, Ambika, Pusa Arunima, Pusa Lalima, Pusa Shreshth, Pusa Pitambar, Pusa Pratibha), dragon fruit, grapes etc (Table 1). The key to his success is his eagerness to learn and understand very soon, hard work and positive attitude. He is a model progressive horticulture farmer for the region.

Market integration

Earlier, Shri. Anoj Kumar Rai being a small time farmer used to sell orchard produce to pre-harvest contractors and local vendors. Once he started growing in large scale, the neighbouring fruit/vegetable vendors came to know about his produce and quality of the fruits grown in the field. Hence the vendors come to his orchard or farm and purchased the produce but later he himself started to do marketing by visiting neighbouring districts viz. Darbhanga, Samastipur and Muzaffarpur and fetched maximum share of consumer price. He has also motivated other farmers in village and neighbouring areas to diversify their orchard.

Earning from this diversity of orchard

The beauty of his farm is that he has utilised every inch of the farm land as a productive asset utilizing vertical space also. By all these crop and processing enterprises, he is earning a handsome income (gross) of more than ₹ 12 lakhs rupees per annum. By raising the field crops/vegetable, he earns ₹ 2.30 lakhs per ha with cost: benefit ratio of 1:1.30. For horticulture crops, he earns ₹ 9 lakhs

per ha with cost: benefit ratio of 1:2.50.

Preparation of value added products of mango, litchi, guava and jamun

During his visit to ICAR-NRC on Litchi, Muzaffarpur, he came to know about the methodology of litchi RTS, squash (of mango, bael, guava, jamun), litchmish, jam of bael /mango/ jamun, aonla candy and preserve available there. He requested us to impart the training on valorization and after receiving two (7 days and 15 days) entrepreneurship development programme, he is now preparing and making many value added products using B and C grade of fruits as he has noticed that the beverages made out of mango, litchi, aonla, bael, guava are highly in demand and economical. It also helps in use of excess produce, thus increase in the income through processing.

Due to our guidance and his painstaking effort, he received FSSAI licence (during March 2022) from Govt. of Bihar for preparation and sale of value added products of mango, litchi, guava, bael and jamun and trying to get registration of his nursery on NHB portal or on Department of Horticulture, Government of Bihar.

Awards and Recognition

For his excellence in the field of Horticulture, he bagged some special awards by Department of Horticulture, Govt. of Bihar (June, 2022) and RPCAU, Pusa, Samastipur, Bihar (March, 2022). He has been awarded for best farmer on *Mosambi* and *Acid lime* grower by Shri. Radhamohan Singh, Former Union Minister on Agriculture and Farmer Welfare, GoI (2020). He has been awarded on many occasion by Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, and Department of Horticulture, Govt. of Bihar for his splendid performances in horticultural and allied activities.

Influence on other farmers

Collecting all the novel and rare varieties of fruits and other crops from the exposure visits made his orchard, a hub of biodiversity models. Many farmers and youth visit his farm to take a glimpse of his success and many have followed his footsteps. Sharing of propagules and plants to those farmers who wish to cultivate the rare fruit sp. or varieties also make their orchard busy with visitors



Peach cv. Pratap



Plum cv. Santa Rosa



Pomegranate cv. Bhagwa

and scholars.

He has also planned to grow more varieties of crops in his field in coming season. He got the demand of processed products of mango, litchi and guava through many exhibitions, *melas*. Apart from farming, he has expertise in other works like pickle making, RTS, squash, jam, jelly, vinegar business and he also have an enterprise

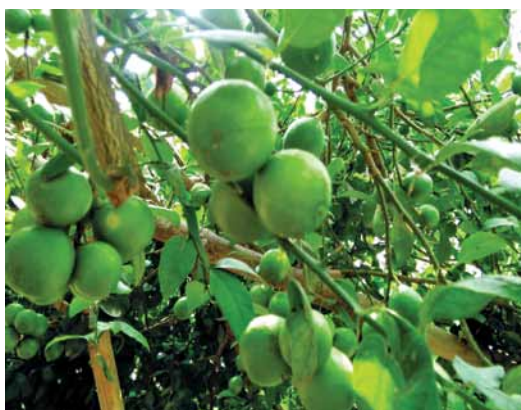
named *Pusa Farmer Producer Company*, Malikaur, Pusa, Samastipur, Bihar. By observing the income and passion of Mr. Anoj Kumar Rai, other orchardists from that locality are also interested in taking up diversified farming like him. He is also into Agro-forestry with Mahogany, Shisham, Sandalwood, Teak and *chah* trees all along the borders of his farmland.

Table 1. Diversity at Shri Anoj Kumar Rai farm

S. No.	Name of crops	Name of varieties	Area covered	Annualized gross return (₹ in lakhs)	
				Before our intervention	After our intervention
1.	Mango	Langra, Chausa, Jarda, Jardalu, Sukul, Paharpur Sinduria, Dashehari, Sipia, Kanchan, Amrapali, Mallika, Kesar, Alphonso, Ambika, Arunika, Banganpalli, Arka Arun, Arka Neelkiran, Arka Puneet, Arka Anmol, Pusa Arunima, Pusa Lalima, Pusa Shreshth, Pusa Pitambar, Pusa Pratibha, Prabha Shankar, Mahmood Behar, Sabri, Sanha, Dalma, Arka Nilanchal Kesri, Raspuri and Totapari (33 varieties)	3 acre	1.50	2.50
2.	Guava	L-49, Sweta, Allahabad Safeda, Pant Prabhat, VNR-bihi, Lalit, Dhawal, Lalima, Arka Mridula, Arka Kiran and Arka Rashmi (11 varieties)	0.5 acre	0.15	0.25
3.	Litchi	Shahi, China, Calcattia, Rose Scented, Gandaki Lalima, Gandaki Yogda and Gandaki Sampada (7 varieties)	1 acre	0.25	0.50
4.	Acid lime	Bikram, Balajee, Baramasi, Sai Sarbati, CCRI-7 and CCRI-8 (6 varieties)	0.5 acre	3.00	5.00
5.	Aonla	NA-7, NA-10	1.0 acre	0.75	1.50
6.	Sweet orange	Mosambi	0.5 acre	0.20	0.50
7.	Grape fruit	Kumquat	5 trees	-	-
8.	Jamun	Rajendra-1, Selection-1, Selection-2, Seedless, J-37 and J-42 (6 varieties)	20 tree	0.20	0.50
9.	Bael	NB-5, NB-7, NB-9, LB-1, LB-2, Sabour-1 and Kagzi-1 (7 varieties)	30 trees	0.05	0.50 (sale of processed product)
10.	Pomegranate	Bhagwa, Super Bhagwa, Solapur Lal (affected by bacterial blight)	20 trees	-	-
11.	Kinnow	PAU-1	20 trees	-	-
12.	Phalsa	Bikaneri	5 trees	-	-
13.	Sapota	West Bengal	5 trees	-	-
14.	Fig	Bengaluru, Balanagar	10 trees	-	-
15.	Mandarin	Nagpur Mandarin (die back affected)	25 trees	0.05	0.10



Raising tomato on brinjal rootstock



Sweet orange cv. Mosambi



Value added products of mango, litchi and jamun being sold by Mr. Anoj Kumar Rai

Table 1 (Concluded)

S. No.	Name of crops	Name of varieties	Area covered	Annualized gross return (₹ in lakhs)	
				Before our intervention	After our intervention
16.	Ber	Umran, Seb, Gola, Thar Sevika, Karaka, Illaichi (menace of bird eating)	10 trees	0.05	0.10
17.	Jackfruit	Deshi, from ICAR-IIHR, Bengaluru	5 trees	-	-
18.	Apricot	Babaco	5 trees	-	-
19.	Pear	Punjab sweet, Bagughosa	10 trees	0.05	0.10
20.	Plum	Satlaj Purple	5 trees	0.05	
21.	Peach	Shan-e-Punjab, Pratap, Flordasun and 16-13 (4 varieties)	25 trees	0.05	0.20
22.	Datepalm	Khadrawi, Zahidi	5 trees	-	-
23.	Loquat	2 plant from Nirmal Nursery, Dehradun	5 trees	-	-
24.	Custard apple	Arka Sahan	5 trees	-	-
25.	Dragon fruit	Collected from ICAR-IIHR, Bengaluru	10 trees	-	-
26.	Cherry	Swarna	5 trees	-	-
27.	Grapes	Thompson Seedless, Bangalore Blue	10 vine	-	-
28.	Apple	Anna, Dorset, HRMN 99, Goldel Delicious, Chauabatia Prince and Mrinal (6 varieties)	25 trees	0.15	0.25
Total return				6.45	12.10
Vegetable crops					
29.	Cauliflower	Luckey, Syngenta	0.50 ha	1.00	1.25
30.	Onion	Agrifound Dark Red	0.10 ha	0.05	0.10
31.	Garlic	G-323, G-50, G-384, G-282	0.05 ha	0.10	0.15
32.	Turmeric	Rajendra Sonia	0.30 ha	0.40	0.50
33.	Elephant foot yam	Gajendra	0.10 ha	0.25	0.30
Total return				1.80	2.30
Timber trees					
34.	Gamhar (<i>Gmelina arborea</i>)		20	-	-
35.	Shisham (<i>Dalbargia sisoo</i>)		100	-	-
36.	Mahogani (<i>Swietenia mahogni</i>)		1500	-	-
37.	Chah		20	-	-
38.	Sagwan		400 trees	-	-
39.	Chandan (<i>Sandalwood tree</i>)		50 trees	-	-
40.	Semal (<i>Salmelia malabérica</i>)		20	-	-



Peach cv. Shan-e-Punjab

SUMMARY

Orchardists always try to increase their yield and income from fruit crops they raise. Whatever crop they might cultivate, the bottom line is to invariably get a good price from their produce. Farmers can increase their income either by intensifying the existing enterprises or can move towards diversification (by growing new

crops, new varieties), value-addition, or successful market linkages to improve their economic level. An excellent example of the strategy is Shri. Anoj Kumar Rai, a physics graduate, vibrant, successful and dynamic orchardist from remote village of Samastipur district of Bihar who was previously cultivating few crops. Now he has diversified his entire orchard with 32 fruit tree species with 115 commercial varieties besides his orchard adored with 33 varieties of mango expanded with at least 5 timber species. Besides providing regular knowledge to its neighbours, his activity is also creating avenues of alternative livelihood for village residents through fruit and varietal diversity, low chill temperate fruits also playing a significant role towards augmenting bountiful income not only for Malikaur village but also for the surrounding areas with curiosity. From the raising almost all fruit crops of the region, he has enhanced income by adopting value addition including harvesting, grading, packaging, processing, nursery husbandry practices himself and do self marketing to enhance his income with economic stability. This overall, is creating a virtuous cycle, which in turn is emboldening the society to attempt newer and more creative products and orchard designs.

For further interaction, please write to:

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SUSTAINABLE DEVELOPMENT GOALS RELATED TO FRUITS AND VEGETABLES



SDGs 2 3

Health benefits of fruit and vegetables
Harness the goodness

Fruit and vegetables have multiple health benefits. They strengthen the immune system, combat malnutrition and help prevent non-communicable diseases.



SDGs 2 3

Diversified diet and a healthy lifestyle
Live by it, a diverse diet

Adequate amounts of fruit and vegetables should be consumed daily as part of a diversified and healthy diet.



SDGs 2 8 12 13 14 15

Food loss and waste
Respect food from farm to table

Fruit and vegetables are worth more than their price. Maintaining their quality and assuring their safety across the supply chain, from production to consumption, reduces losses and waste and increases their availability for consumption.



SDGs 1 2 3 4 5 8 11 12 15

Highlighting the role of family farmers
Growing prosperity

Cultivating fruit and vegetables contributes to a better quality of life for family farmers and their communities. It generates income, creates livelihoods, improves food security and nutrition, and enhances resilience through sustainably managed local resources and increased agrobiodiversity.



SDGs 1 2 3 4 5 8 11 12 15

Sustainable value chains
Foster sustainability

Sustainable and inclusive value chains can help increase production, and help to enhance the availability, safety, affordability and equitable access to fruit and vegetables to foster economic, social, and environmental sustainability.



SDGs 1 2 3 4 5 8 11 12 15

Efficiency and productivity within fruit and vegetable supply chains to reduce loss and waste.



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Source: Fruit and vegetables – your dietary essentials, FAO background paper, FAO, Rome