



Doubling of farmer's income through intervention of goat farming in tribal dominated area of Maharashtra

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It is certified that there is no conflict of interest among the authors in respect of authorship, conducting trials and its findings.

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An effort was made to improve socio economic condition of tribal farmers with the object to attain doubling of income through intervention of goat farming in tribal dominated area of Maharashtra, *i.e.* Nashik and Nandurbar districts during 2016–2017 to 2021–2022. Necessary benchmark survey was done to select tribal farmers randomly. Training on scientific goat farming was imparted to the farmers. Different inputs such as Osmanabadi goat, pellet goat feed, feeder, drinker, roofing material, mineral & vitamin mixture were provided free of cost to all the farmers under Tribal Sub Plan (TSP) programme. Routine deworming, vaccination of goat was done. Regular visit to the goat units was done to check health of goat and interact with the farmers. Average birth weight of kid was 2.496 ± 0.279 kg. Average daily gain of kids was recorded to be 111.61 ± 10.08 g/day. Average single born, twinning born and triplet born of kids were recorded to be 39.99 ± 1.71 %, 56.02 ± 1.22 % and 3.99 ± 0.98 % respectively. 40.00 % farmers from Gawandh, Nashik and 60.00 % farmers from Vinyknagar, Nashik realized doubling of income from selling of goats after 4 years of rearing. It was found that % farmers attained doubling of annual income increased gradually 21.43 % after 2 years to 34.54 % after 3 years and to 36.36 % after 4 years of rearing. Development of value chain and efficient utilisation available resources would be target for enhancement of farmer's income immensely.

Keywords: doubling of income, farmers, goat farming, Maharashtra

Introduction

The Government of India in its annual budget of 2016–2017 set a policy target of doubling farmer's income by 2022. Doubling of farmer's income is a challenge but it is needed and achievable by way of taking initiatives, adopting viable technologies and reforming policy in agriculture and allied sectors. Fundamentally there are three ways in which income of farmers would be enhanced, *viz.* increasing the gross income, reducing the costs of production and stabilizing the income. Goat plays an important role in livestock sector of India [3] due

to its high population (148.88 million). Goat is potential animal for nutritional security, economic upliftment and livelihood improvement of farmers [6, 8, 9]. Goat has very high adaptability in wide range of climatic condition therefore it is called climate resilient future animal. Goat can survive and produce in most adverse condition and convert poor quality roughage into high quality product, *i.e.* milk, meat, skin and fibre [13, 14]. In rain fed condition where agriculture is uncertain and rearing large ruminant is very difficult due to scarcity of feed and fodder, small ruminant like goat could be reared easily [10]. Goat being small animal requires comparatively lesser space and feed, so, hous-

ing and feeding cost is comparatively lesser. Therefore, initial investment cost for starting goat farming is lesser than that of cattle, pig and poultry farming. Goat being hardy animal disease management cost is comparatively lesser in goat [11, 12]. Goat is easy to manage, so children, aged persons and women can easily manage goat for maintenance and production. Package of practices for goat production being easy, adopted by the most of the tribal farmers. Above all goat produce very high quality milk which is rich in amino acid, minerals and vitamins with medicinal properties. Goat meat is rich in protein, energy and fat and it has no prejudice among different religious communities. So, demand of goat meat is all over the country throughout the year, more particularly during festival its demand is skyrocketed. So there is no problem of selling live goat and goat meat in our country. Skin and fibres are of high value. Goat manure being rich in Nitrogen (N), Phosphorous (P) and Potassium (K) is utilised for vegetable and flower production. So, goat farming fits very well in the integrated farming system. As per report [1] Tribal Sub Plan (TSP) programme is a comprehensive strategic approach adopted by Government of India for the welfare and development of scheduled tribes in the country. So, considering all these goat farming was introduced in tribal dominated areas of Nashik and Nandurbar district of Maharashtra for doubling of farmer's income under TSP programme.

Materials and Methods

In 2016, Tribal Sub Plan (TSP) programme was started at TEC, ICAR-IVRI, Pune in collaboration with Maharashtra Animal Husbandry Department at Nashik district and afterwards it spread to Nandurbar district. Nashik district was considered due to highest tribal population (1.56 million out of 10.51 million tribal population) in Maharashtra. Nandurbar district was considered as it was assigned by GOI as aspirant district due to highest percent of tribal out of total population in the district (69.37 %) as per Statistical Profile of ST in India [2]. In Nashik district Peint and Trambakeshwar taluka and in Nandurbar district Akkalkuwa and Dhadgaon taluka were considered for the study. Tribal dominated Nashik and Nandurbar district is characterised by hilly terrain, undulating topography, medium to high rainfall. Farmers are tribal, marginal, resource poor and mostly engaged in agriculture operation and daily wage. Bench line survey was conducted to record information about socio economic condition of farmers.

Based on survey farmers were selected to distribute inputs in different villages in different years phase wise. Criteria for selecting farmers were caste, gender, economic condition and profession. As work was funded by TSP Programme, so only tribal farmers were selected. Regarding gender women farmers were selected mostly as they were mostly involved in animal husbandry activities. The farmers who were economically very poor selected. The farmers who were solely involved in animal

husbandry activities selected, means who had some business or who work somewhere as contractual basis were not considered. So, altogether 70 tribal farmers were selected during 2016–2017 to 2021–2022 for this pilot study. On the day of distribution health of goats were checked, documents of farmers, *i.e.* cast certificate and adhar card were verified and MOU was signed between farmers and our center. Different inputs were Osmanabadi adult goats (1 male + 4 female = 5), pellet goat feed (200 kg), mineral & vitamin mixture (2 Kg), tarpaulin sheet, feeder, drinker etc. Osmanabadi breed of goat was selected due to high twinning percent and it was producing good amount of milk besides meat, *i.e.* dual purpose breed. The milk yield potentiality of Osmanabadi goat is good, *i.e.* 1.00–1.50 l/day. Simultaneously average daily gain of goat, *i.e.* growth of goat is 110–120 g/day. Average adult body weight in male and female is 40.0 kg and 35.0 kg. respectively. So, Osmanabadi breed of goat is considered as dual purpose breed in India. Training was imparted to the farmers on package of practices for goat production and management in local language. Afterwards field visit was arranged for practical demonstration and enhancing confidence level of farmers.

Goats were being maintained in semi intensive system of management. Farmers renovated the existing goat shed with low cost locally available materials. Most of the sheds were made of bamboo, wood, brick, shed net, wire mesh depending on availability and economic condition of the farmers. Roof was made by GI sheet, corrugated iron sheet, tiles, straw, thatched grass etc. Floor was earthen or wooden. Goats were allowed for grazing 3–4 hrs. daily in fallow/forest land. Farmers were feeding Maize, Marvel grass, Dasrath grass, Guinea grass, Hybrid napier etc. as green fodder. Leaves of Subabool, Mulberry, Drumstick, Banyan, Jackfruit, Mango, Acacia, Weeds etc. were fed to the goats depending on availability. Supplied pelleted feed was also provided at 100 g twice daily to each goat. After exhaustion of supplied feed, they were informed about feed formula for preparing concentrate mash feed consisting of maize crust, rice bran/wheat bran, ground nut cake, cotton seed cake, mineral mixture and common salt. Regular deworming and vaccination of goat was arranged for good health and production with the help of local LDO/STO.

Afterwards regular monitoring was done to look after housing, feeding, management of goats. Goats were treated in case of sickness by local LDO and by the Scientists of center during follow up visit to goat units of farmers. Mineral & vitamin mixture was supplied during visit to eliminate malnutrition of goats. Interaction with the farmers were done during follow up visit to rectify housing, feeding and management of goat if there are any shortcomings. Data were collected on performances, disease incidence, mortality and disposal of goats regularly. Average daily gain of kids were recorded up to 6 months of age in farmers' flock by standard method. Average daily milk yield of lactating doe was measured by graduated plastic container for a period of 100–

120 days in farmers' flock. Farmers were requested to sell new born male goats only. Farmers would sell the goats to middleman who used to fix price based on visual observation of goat, *i.e.* musculature and distribution of fat not based on live weight of goats, so income generation from selling of goat was not up to the mark.

Afterwards collected data were made into tabular form, statistically analysed for interpretation and reporting.

Results and Discussion

It was observed from table 1 that in 2016–2017 at Gawandh village, Peint taluka of Nashik district input was distributed to 10 tribal farmers whose baseline income from all sources at the time of survey was Rs. 20,300/-. After 2, 3 and 4 years of rearing goat annual income increased by 115.84, 115.16 and 107.98 % respectively through selling of goats over baseline income. So farmers attained doubling of income in consecutive three years. However, in next year, *i.e.* 2017–2018, in the same village another 10 farmers were given same inputs and average annual income of those farmers from all sources at the time of survey was Rs. 17,500/-. The increase of annual income over baseline income were 88.57, 69.71 and 68.79 % respectively after 2, 3 and 4 years of rearing goat. It means none the year those farmers attained doubling of income.

In 2018–2019 in several villages of Akkalkuwa taluka in Nandurbar district input was distributed to 10 tribal farmers whose average annual income was Rs. 23,400/-, but increase of annual income over baseline income was very poor, *i.e.* 17.84, 18.80 and 23.93 % after 2, 3 and 4 years of rearing goats. However, in the same year inputs were given at Vinyaknagar village, Traimbakeshwar taluka of Nashik district to 10 tribal farmers whose average annual income was Rs. 19,800/-. It was observed that % increase of annual income after 2, 3 and 4 years of goat rearing earning through selling of surplus goats were 152.53, 173.74 and 324.49 % over baseline income at the time of survey. It increased gradually in subsequent years due to better housing feeding and management of goats by the farmers. Farmers attained doubling of income in all the three years indicating continuously better performance of goat and income generation through selling of surplus goats by the farmers in this village.

In 2019–2020 in Zharwad village, Traimbakeshwar taluka of Nashik district different inputs were distributed to 5 tribal farmers whose average annual income from all sources were Rs. 41, 200/-. It was observed that farmers attained increase of annual income by 64.56 %, 72.82 % and 63.11 % respectively through selling of goats in 2, 3 and 4 years of goat farming. So, it indicated that in that village farmers did not attain doubling of income through goat farming even after 4 years of rearing. In the next year, *i.e.* 2020–2021 in the same village another 5 tribal farmers were given same inputs, however income generation was even poorer than those of earlier farmers in

that village. It might be due to COVID pandemic situation while farmers faced lot of problem to maintain their stock properly and scientists were unable to monitor, carry out deworming and vaccination of goats due to restriction of movement which leads to poor performance and mortality of goats which reflected in income generation of farmers.

In 2020–2021, goat, feed and other inputs were provided at Vinyaknagar village of Nashik district to 5 tribal farmers whose baseline income was Rs. 23,600/-. It was observed that after 2 and 3 years of goat rearing % increase of annual income over baseline income was 49.58 and 96.47 %, respectively, so it increased after 3 years of farming fairly. But still it was poorer than that of farmers adopted in the same village in the year 2018–2019 due to COVID pandemic, restriction of movement etc. In the next year, *i.e.* 2021–2022, inputs were distributed at the same village to the 10 tribal farmers whose average annual income from all sources were Rs. 25,000/-. It was found that farmers attained only 53.40 % increase of annual income over baseline income after 2 years of goat rearing through selling of marketable goats. In this year inputs were also distributed at several villages of Dhadgaon taluka, Nandurbar districts to 5 tribal farmers whose average annual income at the time of survey was Rs. 36,000/- and it was observed that they attained only 43.67 % increase of annual income over baseline income through selling of goats after 2 years of goat farming. This lower increase of income was also due to post COVID impact.

It was delineated from table 2, that out of 70 tribal farmers 15 farmers attained more than 100 % increase of annual income over the baseline income during survey through selling of surplus goats while income generation was analysed as per individual farmer. So, 21.43 % farmers attained doubling of income through intervention of goat farming after 2 years of rearing. 30 % farmers attained above 50 but less than 100 % increase of income and 31.43 % attained less than 50 % increase of income. It was also found that 17.14 % farmers were not able to sell goat to earn anything after 2 years of rearing goat. It was observed that out of 15 farmers 8 from Gawandh village (53.33 %), 6 from Vinyaknagar village (40.00 %) and 1 from Zharwad village (6.67 %) of Nashik district attained doubling of income and nobody from Nandurbar (0.00 %) after 2 years of goat farming.

It was delineated (table 3) that out of 55 tribal farmers 19 farmers (34.54 %) attained doubling of income through selling of live goats after 3 years of goat farming which was higher than that % of farmers attained doubling of income after 2 years of goat rearing. 20 % farmers attained below 100 % but above 50 % and 34.55 % farmers attained below 50 % increase of annual income. Only 10.91 % farmers did not realize any income from goat farming but this value was lesser than that after 2 years of goat farming. It was also observed that out of 19 farmers, 8 farmers (42.11 %) from Gawandh, Nashik; 10 farmers (52.63 %) from Vinyaknagar, Nashik and only 1 farmer (5.26 %) from Zharwad village of Nashik district realized doubling of annual income through intervention of goat farming over baseline income.

Table 1. Doubling of farmers' income through goat farming in 2–4 years

Year	Village	Number of farmers received input	Average baseline income from agriculture, daily wage during survey (Rs.)	Average annual income by sale of goats in 2 years (Rs.)	Average annual Income by sale of goats in 3 years (Rs.)	Average annual Income by sale of goats in 4 years (Rs.)	% increase in annual income over baseline income in 2 years	% increase in annual income over baseline income in 3 years	% increase in annual income over baseline income in 4 years
2016–2017	Gawandh, Nashik	10	20,300	23,515	23,377	21,920	115.84	115.16	107.98
2017–2018	Gawandh, Nashik	10	17,500	15,500	12,200	12,038	88.57	69.71	68.79
2018–2019	Akkalkuwa, Nandurbar	10	23,400	4,175	4,400	5,600	17.84	18.80	23.93
2018–2019	Vinyaknagar, Nashik	10	19,800	30,200	34,400	64,250	152.53	173.74	324.49
2019–2020	Zharwad, Nashik	5	41,200	26,600	30,000	26,000	64.56	72.82	63.11
2020–2021	Zharwad, Nashik	5	38,000	3,450	5,700		9.08	15.00	
2020–2021	Vinyaknagar, Nashik	5	23,600	11,700	22,767		49.58	96.47	
2021–2022	Vinyaknagar, Nashik	10	25,000	13,350			53.40		
2021–2022	Dhadgaon, Nandurbar	5	36,000	15,720			43.67		

Table 2. Classification of attainment of increase of income by tribal farmers after 2 years of rearing

Year	Village	Above 100 % increase of income	Above 50 but less than 100 % increase of income	Less than 50 % increase of income	No increase of income	Total farmers
2016–2017	Gawandh, Nashik	4	5	1	0	10
2017–2018	Gawandh, Nashik	4	2	3	1	10
2018–2019	Akkalkuwa, Nandurbar	0	0	6	4	10
2018–2019	Vinyaknagar, Nashik	5	3	2	0	10
2019–2020	Zharwad, Nashik	1	2	2	0	5
2020–2021	Zharwad, Nashik	0	0	3	2	5
2020–2021	Vinyaknagar, Nashik	0	3	2	0	5
2021–2022	Vinyaknagar, Nashik	1	4	1	4	10
2021–2022	Dhadgaon, Nandurbar	0	2	2	1	5
GT		15 (21.43 %)	21 (30.00 %)	22 (31.43 %)	12 (17.14 %)	70 (100.00 %)

Table 3. Classification of attainment of increase of income by tribal farmers after 3 years of rearing

Year	Village	Above 100 % increase of income	Above 50 but less than 100 % increase of income	Less than 50 % increase of income	No increase of income	Total farmers
2016–2017	Gawandh, Nashik	5	4	1	0	10
2017–2018	Gawandh, Nashik	3	2	4	1	10
2018–2019	Akkalkuwa, Nandurbar	0	1	6	3	10
2018–2019	Vinyaknagar, Nashik	8	2	0	0	10
2019–2020	Zharwad, Nashik	1	2	2	0	5
2020–2021	Zharwad, Nashik	0	0	3	2	5
2020–2021	Vinyaknagar, Nashik	2	0	3	0	5
2021–2022	Vinyaknagar, Nashik	NA	NA	NA	NA	NA
2021–2022	Dhadgaon, Nandurbar	NA	NA	NA	NA	NA
GT		19 (34.54 %)	11 (20.00 %)	19 (34.55 %)	6 (10.91 %)	55 (100.00 %)

Table 4. Classification of attainment of increase of income by tribal farmers after 4 years of rearing

Year	Village	Above 100 % increase of income	Above 50 but less than 100 % increase of income	Less than 50 % increase of income	No increase of income	Total farmers
2016–2017	Gawandh, Nashik	5	2	3	0	10
2017–2018	Gawandh, Nashik	3	2	4	1	10
2018–2019	Akkalkuwa, Nandurbar	0	3	4	3	10
2018–2019	Vinyaknagar, Nashik	10	0	0	0	10
2019–2020	Zharwad, Nashik	0	3	2	0	5
2020–2021	Zharwad, Nashik	0	0	3	2	5
2020–2021	Vinyaknagar, Nashik	2	0	3	0	5
2021–2022	Vinyaknagar, Nashik	NA	NA	NA	NA	NA
2021–2022	Dhadgaon, Nandurbar	NA	NA	NA	NA	NA
GT		20 (36.36 %)	10 (18.18 %)	19 (34.55 %)	6 (10.91 %)	55 (100.00 %)

Table 5. Performance of Osmanabadi goat in adopted villages of Nashik and Nandurbar district

Year of distribution	Village	Number of farmers	Birth weight of kid (Kg)	Average daily gain in weight (g/d)	Average daily milk yield (ml/d)	% of single born kid	% of double born kid	% of triple born kid	Average annual mortality (%)
2016–2017, 2017–2018	Gawandh, Nashik	20	2.607	120.45	400	41.75	53.40	4.85	11.59
2018–2019, 2020–2021, 2021–2022	Vinyaknagar, Nashik	25	2.580	108.70	475	43.00	55.16	1.84	10.48
2019–2020, 2020–2021	Zharwad, Nashik	10	2.220	105.20	410	29.63	62.96	7.41	12.43
2018–2019, 2021–2022	Akkalkuwa & Dhadgaon, Nandurbar	15	2.575	112.10	450	45.58	52.57	1.85	11.10
Overall			2.496±0.279	111.61±10.08	433.75±12.76	39.99±1.71	56.02±1.22	3.99±0.98	11.40±0.59

It was revealed from the study on livelihood improvement of tribal farmers through goat farming of 4 years (table 4) that 20 tribal farmers. *i.e.* 36.36 % farmers attained doubling of annual income through goat production and management, 10 tribal farmers, *i.e.* 18.18 % attained more than 50 % but below 100 % increase of income and 19 tribal farmers, *i.e.* 34.55 % farmers realised <50 % increase of annual income out of 55 farmers. Similar to earlier 10.91 % tribal farmers did not realize any income from goat farming. Analysis as per village revealed that out of 20 tribal farmers, 8 tribal farmers (40.00 %) from Gawandh, Nashik and 12 tribal farmers (60.00 %) from Vinyaknagar, Nashik realized more than 100 % increase of annual income, *i.e.* doubling of income from selling of surplus goats after 4 years of rearing.

Performance of Osmanabadi goat was found to be optimum in field condition under optimum housing, feeding and management. Birth weight of kids was observed to be highest in Gawandh village of Nashik district with an average birth weight of 2.496±0.279 kg. Similarly average daily gain in weight of kids was also highest in Gawandh, Nashik with an average daily gain of kids was recorded to be 111.61±10.08 g/day. Average daily milk yield of doe was highest in Vinyaknagar village of Nashik district with an average daily milk yield of 433.75 ml/day which was utilized for household consumption. Highest single born kids were recorded in Akkalkuwa & Dhargaon of Nandurbar district whereas highest twinning % and triplet % of kid born were recorded in Zharwad, Nashik. Average single born, twinning born and triplet born % of kids were recorded to be 39.99±1.71 %, 56.02±1.22 % and 3.99±0.98 % respectively. Highest annual goat mortality was observed at Zharwad, Nashik, whereas least annual mortality of goat was recorded in Vinyaknagar, Nashik with an average annual mortality of 11.40±0.59 %. Goats mostly suffered from pneumonia and enteritis. The findings were in corroborated with the findings of [4, 5] (table 5).

So, based on analysis of increase of annual income as per individual farmer, it could be inferred that % farmers attained doubling of annual income increased gradually 21.43 % after 2 years to 34.54 % after 3 years and to 36.36 % after 4 years of rearing. Simultaneously % of farm-

ers not realized income gradually reduced from 17.14 % after 2 years to 10.91 % after 3 and 4 years of rearing also in selected talukas of Nashik and Nandurbar district of Maharashtra. Only in Gawandh and Vinyaknagar villages of Nashik district tribal farmers attained doubling of income after the 4 years of rearing goat. To achieve in this direction few steps need to be taken, *i.e.* enhancing productivity of animals and sustainability of production by adopting improved housing, feeding, breeding and health management practices of goat, efficient utilisation of farmers' available resources for reducing cost of production, reducing dependency on middleman who used to take away profit from the farmers. Farmers should plan breeding of goat in such a way that marketable goats in sufficient number would be available during festival time to fetch more income. Development of value chain is the need of the hour which means goat production should be linked with market, so product diversification, processing, value addition, packaging and branding needs to be taken care for earning more income [7]. Improving quality of the products to fetch more income by the farmers. Even after hygienic slaughter meat would be exported to Middle East countries where demand of goat meat is very high. Goat milk is another avenue of earning, due to its several positive attributes as well as medicinal properties. Goat based integrated farming system would be another option for efficient utilisation of available resources, nutrient recycling towards enhancing income of farmers. Farmer should attend training and capacity building programme time to time for updating of knowledge. Reducing input costs, *i.e.* cost of feed & fodder, medicine & vaccine, etc. by Government agency would help farmers for producing goat and goat products at low cost. Reforming marketing policy by Government agency, *i.e.* selling of goats on the basis of live weight rather than visual observation. Even strengthening of linkage with different Government institutes, Organizations, NGOs to get latest information on different know-hows, schemes and different activities going all over the country which will help farmers to attain doubling of income. So, more and more farmers will achieve the goal of doubling farmer's income in the long run through intervention of goat farming.

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Подвоєння доходів фермерів через зміни у веденні козівництва в регіонах штату Магараштра, де переважають племена

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Від 2016–2017 до 2021–2022 рр. було зроблено спроби покращити соціально-економічне становище племінних фермерів з метою подвоєння їхніх доходів через втручання у ведення козівництва в районах Магараштри, де переважають племена, тобто в районах Нашік та Нандурбар. Для початку провели необхідне контрольне опитування серед племінних фермерів для їх випадкового відбору. Для них провели вишколи з наукових засад козівництва. В рамках програми Племінного підплану (TSP) всім фермерам безкоштовно надали різні ресурси — кіз породи Османабаді, гранульований корм для кіз, годівниці, напувалки, покрівельний матеріал, мінеральні та вітамінні суміші. Провели планову дегельмінтизацію та вакцинацію кіз, організували регулярне відвідування козівницьких господарств для перевірки здоров'я кіз та контакту із фермерами. Середня вага козеняти при народженні становила $2,496 \pm 0,279$ кг. Середньодобовий приріст козенят становив $111,61 \pm 10,08$ г/день. Середня кількість козенят, народжених поодиночці, двійнят і трійнят становила $39,99 \pm 1,71$ %, $56,02 \pm 1,22$ % та $3,99 \pm 0,98$ % відповідно. 40,00 % фермерів з Гаванда (Нашік) та 60,00 % фермерів з Віньянагара (Нашік) подвоїли дохід від продажу кіз після 4 років вирощування. Встановили, що відсоток фермерів, які досягли подвоєння річного доходу, поступово зростав з 21,43 % через 2 роки до 34,54 % через 3 роки та до 36,36% через 4 роки вирощування. Розвиток ланцюжка створення вартості та ефективне використання доступних ресурсів будуть метою для значного збільшення доходів фермерів.

Ключові слова: подвоєння доходів, фермери, козівництво, Магараштра