Case Study

Introducing pigeon pea as a major kharif pulse crop in maize-based cropping systems

The Challenge

Koraput district, the southernmost district in the state of Odisha, India, is famous for its rich biodiversity. More than 70 per cent of the farmers are small and marginal landholders with an average landholding of 1.63 hectare and operational holding of 0.6 hectare (GoO, 2011). The district has high level of poverty at 83 per cent as compared to the state average of 47 per cent. It is also a district with high burden of malnutrition with 49 per cent children under five years of age underweight and 57 per cent stunted (GoO, 2015). Further, more than 60 per cent cultivable land in the district is upland and both small and marginal farmers have a higher percentage of landholdings in uplands vis-à-vis low and medium lands. Agriculture is largely rainfed and *kharif* is the main cropping season. Rice is the predominant crop in the region followed by finger millet, which is mostly raised on marginal lands in the upland and hilly regions with few external inputs, either as a pure crop or with a range of pulses, legumes and oilseeds under mixed cropping system.

A balanced diet should include recommended amounts of different food groups that provide the necessary nutrients for a healthy life. Pulses as a source of food can provide protein and minerals required by the body; further, the sale of surplus produce can be a source of additional income for small marginal farmer households.

Introduction

Intercropping of pigeon pea and maize was undertaken as one of the interventions of the Farming System for Nutrition (FSN) study in Koraput under the research programme on Leveraging Agriculture for Nutrition in South Asia (LANSA). The study focused on mainstreaming the nutrition dimension in the design of the farming system encompassing crop-livestock-nutrition garden-fisheries along with nutrition awareness activities (Bhaskar et al. 2017).

Background

Farmer in his maize pigeon pea field

This case study examines the impact of maize and pigeon pea intercropping across seven villages in Boipariguda block of Koraput district. The population of the study villages is predominantly dependent on agriculture with 73% of the village households having either cultivation or agricultural labour as the primary occupation. A majority of the households were marginal farmers with less than a hectare of land. Rice occupies bulk portion of land acreage irrespective of land types. However, in upland areas, farmers either cultivate finger millet or maize or leave the land fallow in kharif. They usually do sole cropping of maize; in certain cases, mixed cropping i.e. physical mixing of maize seeds with seeds of cucurbits/gourds or pulses like pigeon pea or black gram is done. The seeds are usually broadcasted in the field without any proper crop management practices. The baseline survey in 2014 indicated high levels of undernutrition and that the household diet was largely cereal dominated with consumption of all other food groups being less than the recommended levels. It was found that the average consumption of pulses at 39.4 g per capita per day was less than the recommended RDI of 75 g/day and they were largely being sourced from the market.. (Pradhan et al.2017). This could be due to problems of availability and affordability. Introducing a kharif pulse crop in the cropping system of the area to increase availability of nutrient dense crop was a major component of the FSN design.

Several discussions were held with stakeholders, subject experts, local people, and intercropping of legume with cereals came up as a recognized practice that could be promoted for increasing productivity and profitability per unit area and also availability of nutrient dense food. Considering that maize was already being grown by the tribal farmers, consumption of pigeon pea dal by households was largely being sourced from the market and suitability of pigeon pea to be grown as a kharif season crop, maize-pigeon pea intercropping was finalized as one of the interventions under FSN. The nutritive value of maize and pigeon pea are given in **Table 1**.

Table 1: Nutritive value of maize and pigeon pea

Type	Protein (g)	Energy (KJ)	Total Folate (µg)	Total Carotenoids (µg)	Calcium (mg)	Iron (mg)	Zinc (mg)
Maize dry	8.80	1398	25.81	893	8.91	2.49	2.27
Maize tender	3.57	502	62.96	1428	6.35	0.71	0.97
Pigeon Pea dal	27.70	1384	108	484	71.73	3.90	2.63
Pigeon Pea whole	20.47	1146	229	579	139	5.37	2.99
Pigeon Pea tender (fresh)	8.09	520	94.21	495	58.58	1.18	1.10

(All values are expressed per 100 gm of edible portion)

Source: *Indian Food Composition Tables, 2017, NIN, Hyderabad*

Intervention and outcome

A trial was laid out in the fields of 13 farmers in Boipariguda block covering an area of 0.7ha under rainfed condition in *kharif* 2015-16. The study focused on assessing performance of pigeon pea variety NTL-30, a high yielding long duration variety, as an intercrop with maize in 1:1 ratio using improved agronomic practices; this included line sowing @ 60x30 cm for maize and 60x60 cm for pigeon pea with other recommended intercultural operations. For increased production of maize, a nutrient-dense maize variety NHM-51 was introduced in place of local varieties. Fertilizer recommendation for maize was 80:40:40 Nitrogen (N), Phosphorous (P), Potassium (K) kg ha^{-1} and for pigeon pea 20:40:20 NPK kg $ha^{-1.}$ As it was an intercropping trial, 50% of the fertilizer recommended for maize and pigeon pea were taken into consideration and accordingly, a blanket dose of NPK kg ha^{-1} in ratio of 50:40:30 was applied. 25 per cent N and full P and K was applied at the time of sowing. The remaining 50 per cent N was applied at first hoeing and earthing up, and the balance 25 per cent of N was applied at second hoeing and earthing up. Top dressing of fertilizers coincided with hoeing/earthing up operations for better incorporation of the applied nutrients into the soil for greater availability. Weeding was performed twice. The first weeding was done 15-20 days after sowing (or before the first hoeing) by hand weeder. The second weeding was 40-45 days after sowing (or before the second hoeing). Chloropyriphos 20 EC @ 5 ml lit^{-1} was applied to control attack of termites in maize and Triazophos 40 EC @ 2ml lit^{-1} was applied to control leaf eating caterpillars in pigeon pea. The harvest from the study trial yielded 4585 kg/ha of tender maize, 341 kg/ha of grains, and 4128 kg/ha of green fodder along with 349 kg/ha of pigeon pea tender pods and 356 kg/ha of pigeon pea seeds. Green fodder was used as cattle feed and mature maize grains were dried and used as snack (popcorn). Economics of the intervention was calculated by converting the size of the plot into hectare. The cost of cultivation (A) included expenses (both for inputs and hired labor) incurred during land preparation/ sowing/ nutrient application/ weeding/ harvest while gross return was calculated by multiplying the total return with their market price (**Table 2**).

Farmer in her maize pigeon pea intercropping field

Table 2: Economics of Maize-Pigeon pea crop production (per ha)

Total cost of cultivation (A)	INR 27,600		
Total Production	kg	Price (INR /kg)	Total (INR)
Maize (Tender)	4585	10.00 (Local)	45,850.00
Pigeon Pea (Tender pods)	349	30.00 (Local)	10,470.00
Pigeon Pea (Seed yield from mature pod)	356	46.25 (MSP)	16,465.00
Gross return (B)			72785.00
Net return (B-A)			45185.00

MSP: Minimum Support Price; INR: Indian National Rupees

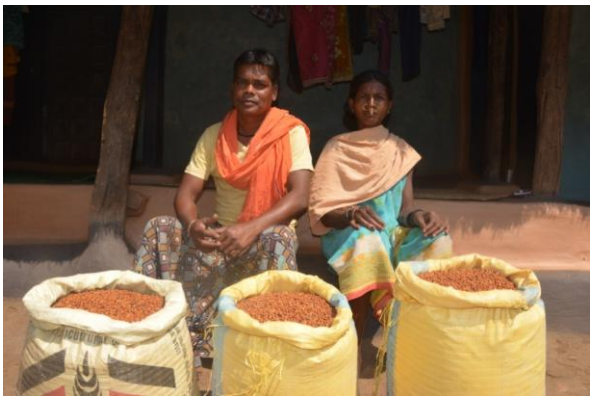
Regular trainings on package of practices, field observation day, farmer's field day and awareness on importance of pulse consumption were organized for the community with technical help from the Krishi Vigyan Kendra and Regional Research Technology Transfer Station, Semiliguda. Trainings on safe seed storage and distribution of triple layered polythene bags were also done so that farmers can save the seeds for growing in next season. The awareness programmes along with results of the on farm demonstration in 2015-16 motivated more farmers to adopt this intercropping system in subsequent years (276 farmers in 2016-17 and 242 in 2017-18). Table 3 gives the year-wise detail of the intervention.

Table 3: Maize Pigeon Intercrop (2015-17)

Year	Details of intervention & project support	No of Farmers	No. of villages	Total area (ha)	Average yield (kg per ha)		
					Maize tender	Pigeon pea tender pods	Pigeon pea grain
2015-16	**Demonstration-**100% input (seed, fertilizer, pesticide/insecticide) support and technical advisory.	13	3	0.7	4585	349	356
2016-17	**Intervention year-1** Seed, 50% fertilizer cost and technical advisory	276	21	14.4	4905	627	329
2017-18	**Intervention year 2**: Only technical advisory	242	22	14.0	4336	658	356

An endline survey of 190 households (HHs) on food consumption pattern in 2017 indicated that 111 HHs were consuming pigeon pea dhal as compared to 24 HHs during the baseline in 2014. Due to increasing availability and better nutrition awareness, average consumption of pigeon pea dhal increased from 32.94g/CU in 2014 to 50.36g/CU in 2017 and average consumption of tender maize increased from 245g/CU in 2014 to 281.90g/CU in 2017. Besides increasing availability for household consumption, the returns from sale of tender maize and pigeon pea supplemented household incomes.

Conclusion



Farmer with pigeon pea harvest

The success of the intervention found farmers bringing fallow land and under-utilized upland under cultivation of maize and pigeon pea. Starting with 13 farmers in 3 villages in 2015-16 covering an area of 0.7ha to 242 farmers from 22 villages covering an area of 14 ha with only technical support from the project in 2017-18, indicates the positive impact and acceptance of the intervention by the local community. For sustainability of the intervention and to ensure consumption of pigeon pea produce as dal, a pigeon pea dhal processing mill was established in one of the project villages. This will avoid the forced sale of whole pulses at lower price and purchase of processed dhal at higher price. The famers have also been linked with 'VIKAS *MAHASANGH*' - a Farmers' Federation facilitated by MSSRF in Boipariguda Block, for getting access to quality seed, fertilizers, financial support and market linkage.

Box 1

"I am a small farmer with 0.9 acres of land. I did intercropping of maize and pigeon pea in 0.4 ac area in 1:1 ratio with an inter-row distance of 3 feet. I also applied required amount of fertilizers. I got 2 quintals of maize and 1.5 quintals of pigeon pea from the same field. Earlier, the yield of pigeon pea from mixed cropping with maize in the same patch of land was only 20 – 30 kg which was insufficient to meet my family's consumption requirements. Similarly, maize production was very low and used to get over after few rounds of family consumption and distribution among relatives. Now I am no more dependent on the market for buying pigeon pea dal. The higher yield of both the crops has enabled me to distribute maize and pigeon pea dal to my relatives after keeping aside amount required for my family's consumption for a year. The line sowing method has also made hoeing, weeding and earthing up, a lot easier. This has been a good learning experience for me. I hope to continue using the technologies and methods that I have learnt, in future as well, so that I continue to get better yield which in turn will satisfy the food and nutritional needs of my family members."

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Village: Dumuriguda, Koraput

References

Bhaskar, A. V. V., Nithya, D. J., Raju, S., and Bhavani, R. V. (2017). 'Establishing integrated agriculture-nutrition programmes to diversify household food and diets in rural India', Food Security, 9, pp. 981-999.

Government of Odisha-GoO (2011). District Statistical Hand Book of Koraput. Directorate of Economics and Statistics, Bhubaneswar.

Government of Odisha-GoO (2015). Odisha Agriculture Statistics (2013-14). Director of Agriculture and Food Production, Bhubaneswar.

Pradhan, A., Panda, A. K., Bhaskar, A. V. V. (2017). Crop based Demonstrations and Trials under Farming System for Nutrition Study in Koraput (2013-16). MSSRF / RR / 17 / 43.

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