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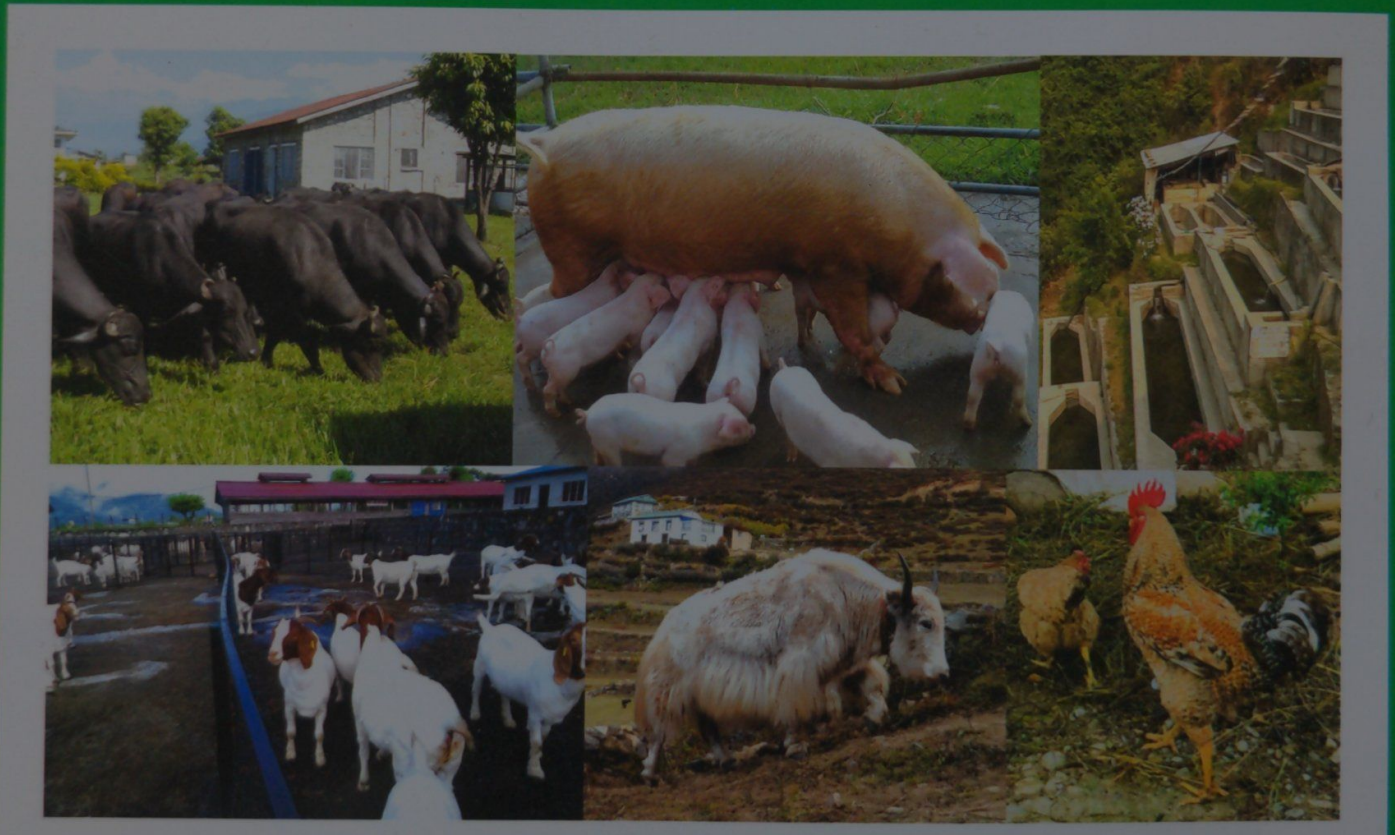

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CSCIP-Nepal and its overall achievements for Nepal's dairy farmers

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Abstract

Cool Season Crop Improvement Programme – Nepal (CSCIP-Nepal) was a New Zealand Government funded four-year programme with a long-term goal of improving fodder seed supply, food security and farmer's financial security. CSCIP-Nepal worked with six dairy co-operatives (200 farmers) in two Mid-hill and two Terai districts. Winter fodder production was primarily from forage oat, and summer fodder production from teosinte. Increasingly farmers grew berseem clover or vetch with their forage oat crops. Farmers, mainly women, were trained in fodder crop production. Within four years green fodder yields within the co-operatives had tripled (to an average of 63 t/ha for winter fodder and 96 t/ha for summer fodder). Increased green fodder supply allowed a reduction in concentrates and straw fed to animals, which decreased the cost of milk production. Milk yield increased by an average of 2.3litres/animal/day, a 35% increase. Household income from milk sales increased by an average of NR59,306 (US$560) per annum, providing farmers with the opportunity to escape rural poverty.

Keywords: *Fodder, Forage oats, Household incomes, Milk yields, Teosinte*

Introduction

For Nepal's 500,000 households engaged in dairy production (Pariyar et al., 2017), growing fodder was not traditionally practiced. Rural women were off-farm gatherers of poor-quality fodder. This inadequate fodder feed supply and the associated poor animal nutrition, particularly in winter/spring, were the biggest constraints to milk production and a major impediment to improving cash incomes and rural livelihoods (Pariyar, 2004; Armstrong et al., 2011). National fodder deficits at that time ranged from 36% in the lowlands (Terai) to 56% in the high hills (Hampton et al., 2015).

While fodder production based on forage oats was introduced to Nepal through programmes funded by the Asian Development Bank and FAO (Pariyar 2004; Stevens et al, 2004) the positive outcomes from these projects did not spread widely outside the project areas. In 2008 a New Zealand Government funded three-year pilot programme 'Developing sustainable animal fodder systems for improving household incomes in several districts of Nepal' began operations (Armstrong et al., 2011), concentrating on cropping of forage oats (*Avena sativa*) in winter and of sorghum (*Sorghum bicolor*) in summer. The outcomes included (i) a substantial (up to 50%) reduction in the time rural women were involved in fodder gathering, (ii) milk yield increases of between 2 to 3 litres/day; (iii) a NR 4 to 8/litre reduction in the cost of milk production (because of a reduction in the use of feed supplements); and (iv) incomes more than doubling for the 10,800 households who adopted the project's fodder production technologies.

By 2014 the Nepal Agricultural Research Council (NARC) and the Department of Livestock Services (DLS) had replicated the fodder extension model developed in the 2008-2011 project to over 100,000 households, but this success created a problem, a shortage of seed. Domestic seed supply could not meet demand, and much of the seed available was of poor quality (Pariyar & Shrestha, 2016). This was identified as a major factor restricting the long-term sustainability and growth of fodder for animal feeding. Overcoming this seed supply constraint was the major goal of the second New Zealand Government funded programme 'Cool Season Crop Improvement Programme for Nepal' (CSCIP-Nepal) which began in 2015. However, in this paper, we will report only on the programme impact on dairy production (medium-term outcome (i); Figure 1).

Long-term outcome:	Improved seed supply, food security and farmers' financial security.
Medium-term outcomes:	(i) Improved fodder seed production and mechanisation systems have improved fodder supply and animal performance. (ii) Technologies are being replicated to new communities.
Short-term outcomes:	(i) Community based seed production established and running effectively. (ii) Community based seed supply linked to national seed chain and quality assurance standards. (iii) Best mechanised systems implemented in communities by farmers.

Figure 1. Cool Season Crop Improvement Programme-Nepal; long, medium and short-term outcomes.

Methodology

CSCIP-Nepal worked with six dairy co-operatives in the Dhading and Kavre districts of the Mid-hills (1000-1500 masl) and Banke and Sunsari districts of the Terai region of Nepal (140-200masl). Two hundred rural household farmers whose major source of income was selling milk from their dairy cows or buffalo participated (Pariyar et al., 2017). Winter fodder production was from forage oats, initially as a monoculture, but beginning in 2017, increasingly with a companion legume, either berseem clover (*Trifolium alexandrinum*) or vetch (*Vicia sativa*). Summer fodder production was from teosinte, mostly as a monoculture but occasionally with cowpea as a companion legume.

Fodder crop establishment was as described by Pariyar et al., (2017). Depending on location, winter fodder crops were sown in October-November with the first harvest cut between 50-60 days after sowing (DAS). Summer fodder crops were sown during May-June with the first harvest cut at 43-53 DAS. For both winter and summer crops, two further cuts were taken at 30-days intervals. In May 2015 a base-line survey was undertaken by the staff of the NARC Pasture and Fodder Division which provided initial information on fodder production, animal performance and householder incomes. NARC and DLS staff then worked directly with the farmers, providing training and advice on site selection, land preparation, sowing times and rates, agronomic management, and cutting timing and frequency. Fodder was hand cut and fed fresh to the cows/buffalo as required. At the end of each winter and summer production seasons a total of 64 farmers from within the six co-operatives were randomly selected for data

collection for comparison with base-line survey data. New farmers were selected for the survey each year.

Results and Discussion

Before CSCIP-Nepal began, the average winter green fodder yield for the six co-operatives was 17 t/ha, ranging from 9 t/ha in Kavre to 32 t/ha in Banke. By the end of 2018 the average winter green fodder yield had increased to 63 t/ha, ranging from 41 t/ha in Kavre to 108 t/ha in Banke. Banke yields were double those of the other three districts because farmers had access to irrigation. This nearly tripling of winter green fodder yield was a result of improved management of the crop, including higher seed quality, soil testing to determine fertiliser requirements, and cutting time height and frequency (Pariyar et al., 2018; 2019). The addition of legumes also contributed to increased green fodder yield.

For summer green fodder the average yield increased from 17 t/ha to 96 t/ha, with production lower in Kavre (54 t/ha) than the other three districts (93 to 139 t/ha) because of cooler summer temperatures. Because the green fodder was grown near the house, the time taken by women to collect fodder was reduced by an average of 1.2 h/day. The time saved was used in other productive activities (Pariyar et al., 2017) including growing vegetables. The increased quantities of green fodder available allowed farmers to increase the quality fed to a milking animal each day, from an average of 21.8 kg to 31.0 kg/animal/day (Table 1). This allowed an average 27% reduction in concentrate and 32% reduction in straw fed to the animal per day. Improved feed quality increased milk yield by an average 2.3 litres/day (a 35% increase), and because less feed had been purchased, the cost of milk production was reduced by NR 11.5/litre (Table 2).

Table 1 Impact of CSCIP-Nepal on feed for milking animals, milk yield and cost of milk production.

	Baseline	2018	Difference
Fresh green fodder fed (kg/animal/day)	21.8	31.0	+42%
Concentrate fed (kg/animal/day)	3.3	2.4	-27%
Straw fed (kg/animal/day)	7.3	5.0	-32%
Milk yield (litre/animal/day)	6.5	8.8	+35%
Cost of milk (NR[1]/litre)	42.5	31.0	-27%

[1] US$1 = NR106

Milk yield increases per animal were very similar among all four districts, but the extra income per day for a household ranged from NR 165 to NR 296 (Table 2). These differences reflected the differences in the number of animals per household (Table 2). For a lactation period of 264 days and a milk price of NR60/litre, household annual incomes from milk sales increased by an average of NR59,376, with a range from NR 43,560 in Sunsari to NR78,144 in Banke (Table 2). The combination of increased milk yields and reduced feed costs resulted in at least a doubling of the net income for a milking animal in all four districts (data for Kavre and Banke only presented in Table 3).

Table 2. Impact of CSCIP-Nepal on household income from milk sales in four districts of Nepal.

District	Avg. milk yield increase (litre/animal)	Avg. animals per household (number)	Extra income per household (NR/day) [1]	Net additional income per household (NR)[2]
Dhading	2.26	1.56	212	52,968
Kavre	2.34	1.70	238	62,832
Banke	2.27	2.18	296	78,144
Sunsari	2.33	1.18	165	43,560

[1]based on a milk price of NR60/litre; [2]based on a lactation of 264 days

Table 3. Cost-benefit analysis for milk production per animal before and after CSCIP-Nepal intervention in Kavre and Banke. [1]

	Kavre (Mid-hills)			
	Winter		Summer	
	baseline	2018	baseline	2018
Milk yield (litre)	7.38	9.95	7.17	9.65
Production cost per litre	40	29	43	32
Gross income per animal	443	597	430	579
Net income per animal	146	308	120	269
	Banke (Terai)			
Milk yield (litre)	6.04	8.67	5.18	7.94
Production cost per litre	40	29	50	36
Gross income per animal	362	520	311	476
Net income per animal	122	266	50	191

[1]Cost and income data are NR.

As well as milk yield, dung yield per animal also increased by an average of 2.9 kg/day, thus providing move farmyard manure for crop production. Year-round on-farm fodder production for animal feeding was not a traditional practice in Nepal. Fodder scarcity, particularly in winter, resulted in poor animal productivity, a significant contributor to rural poverty. Poorly fed lactating animals produce low milk yields, trapping farmers into a subsistence poverty cycle from which it is difficult to escape. CSCIP-Nepal, following on from the pilot programme described by Armstrong et al. (2011) used a participatory approach whereby scientists, technicians and farmers worked together to develop simple, affordable and sustainable quality fodder production and utilization technology that can be replicated elsewhere (Pariyar et al., 2017). On-farm fodder production is now practiced by some 450,000 households in Nepal (Ram Prasad Ghimire, personal communication, 2019), based almost entirely on forage oats and teosinte. Reliance on single species is a risk, and this is being mitigated by research currently being undertaken by the NARC Pasture and Fodder Division on production/feed quality of alternative grass and legume species for use in dairy systems. The increases in milk yield obtained were largely from genetically unimproved livestock. There is now an opportunity through a breeding programme to introduce genetically improved animals capable of better utilising the quality fodder now being produced.

Conclusion

CSCIP-Nepal employed a journalist to document the development and achievements of the programme. The following is extracted from interviews with farmers from Dhading.

Journalist: When did you start fodder cultivation?

Farmer 1: I did a bit initially, but the production was poor because I had no technical knowledge. Over the last four years I have been trained on fodder production which has allowed me to increase yield. I have also been taught a proper feeding management to increase milk yield. It has made our life much easier, especially for us women. It used to be difficult to feed our family year-round, but this is no longer a problem. We now have three milking animals. The cost of milk production has decreased, and our income has doubled. All this has been made possible through the knowledge we gained through the training. We are really happy with our increased income through fodder cultivation.

Journalist: Has your economic status changed after being involved in fodder cultivation?

Farmer 2: I had a very bad economic situation; I have been through much hardship in my life. Now my economic status has improved a lot. I have bought a piece of land, built a house, and my children now go to college.

These responses typify what CSCIP-Nepal has achieved for Nepal's dairy farmers.

Acknowledgments

We sincerely thank the Nepalese farmers who collaborated so willingly, and all of the dedicated Pasture and Fodder Division and Livestock District Services Office staff who worked so closely with the co-operatives over the four years of the programme; your technology transfer skills were vital for CSCIP-Nepal. We thank Mrs Sunita Sanjyal for translating the farmer interviews, and Flexiseeder Ltd for providing machinery for the programme. Finally, we acknowledge the funding from the NZ Aid Programme of the Ministry of Foreign Affairs and Trade.

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SAADC 2019 Program Schedule

November 8 Day 1: Opening and Plenary Sessions (Hall: Manaslu)			
TIME	**TOPIC**	**SPEAKER/ RESPONSIBLE**	**Country**
8:00-9:00 am	Breakfast and registration	SAADC Organizers	
9:00 am-11:00 noon	**OPENING SESSION**		
11:00 am-12:00 noon	**LUNCH BREAK**		
12:00- 12:30 pm	**Keynote speech 1:** Impact of climate change on smallholder farming in developing countries	Dr. Peter Wynn	Australia
12:30- 1:00 pm	**Keynote speech 2:** Smallholder Livestock Supply Chain in Developing Countries	Dr. MN Lohani	USA
1:00- 1:30 pm	**Keynote speech 3:** Sustainable livestock farming and entrepreneurial opportunities	Mr. Anand Bagaria	Nepal
1:30- 1:40 pm	**COFFEE BREAK**		
1:40- 2:05 pm	The Impact of Mycotoxins in Food and Feed: Consequences for Human and Animal Health	Dr. WL Bryden	Australia
2:05- 2:30 pm	CSCIP-Nepal and its overall achievements for Nepal's dairy farmers	Dr. JG Hampton	New Zealand
2:30- 2:55 pm	Farmers' Perception on Sustainability of Goat Production in Nepal	Dr. SN Mahato	Nepal
2:55- 3:20 pm	Fishery and aquaculture in Nepal: Increasing contribution to food and nutrition security	Dr. TB Gurung	Nepal
3:20- 3:30 PM	**COFFEE BREAK**		
3:30- 3:55 pm	A Model for Collaborations between Minority Land Grant Institutions in the US and Nepal for Sustainable Animal Agriculture Research, Teaching and Extension	Dr. Olga Bolden-Tiller	USA
3:55- 4:20 pm	Role of Federal Policy for Enhancing Sustainable Animal Agriculture in Nepal	Dr. Banshi Sharma	Nepal
4:20- 4:55 pm	The Yak and people in the Asian Highlands	Dr. Ruijun Long	China
4:55- 5:20 pm	The use of feed additives to reduce enteric methane emissions from cattle	Dr. Ermias Kebreab	USA
5:20- 5:45 pm	Climate Change: Implications for Enhancing Livestock Production	Dr. Gopal Reddy	USA
6:00- 9:00 pm	**WELCOME DINNER**		
November 9 Day 2: Parallel session I Animal Breeding and Genetics (Hall: Himchuli)			
TIME	**TOPIC**	**SPEAKER**	
Morning session: Chair Dr. Yoshiaki Hayashi and Dr. Bhuminand Devkota/ Rapporteur: Dr. Narayan Prasad Sharma and Dr. Lok Nath Paudel			
9:00- 9:25 am	Current status and future possibilities of goat and buffalo productions in developing countries	**Yoshiaki Hayasi (Lead Speaker)**	Japan
9:25- 9:40 am	Evaluation of effects of multiple SNPs (H-FABP, CAST, MC4R, and POU1F1) on economic performance in purebred pigs: Growth and Carcass traits	Ling Ling Lo	Taiwan
9:40- 9:55 am	Increased productivity as a route to sustainability for small-scale livestock farming Richard Manlove	Richard Manlove	UK
9:55- 10:10 am	Seminal Attributes and Semen Cryo-banking of Nepalese Indigenous Lulu (Bos taurus) Bull under Ex-situ Conservation	Pankaj Jha	Nepal
10:00- 10:25 am	The Results of Sperms Non-Conventional Cryopreservation of Selected Indonesian Local Small Ruminants	Gatot Ciptadi	Indonesia
10:25- 10:40 am	Performance of Production and Appearance of Buffalo in the High and Low land Environment	Agus Budiarto	Indonesia
10:40- 10:50 am	**COFFEE BREAK**		
10:50- 11:15 am	Buffalo Reproduction Technology	**Bhuminand Devokta (Lead Speaker)**	Nepal
11:15 -11:30 am	Genetic and non-genetic factors influencing milk production traits of buffaloes (Bubalus bubalis) in Nepal: Review	Nirajan Bhattarai	Nepal
11:30- 11:45 am	Is Second-Lactation Milk Yield of Dairy Cows Affected by Number of Days Milked, Year and Season of Birth?	Luqman Hakim	Indonesia