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Up-scaling Fodder Oats (*Avena sativa* L.) Production through Adoptive Research: Evidence from North-western Himalayas

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Fodder deficit during lean period is one the major challenges animal husbandry has been facing in the hills. This impacts the animal health as well as the productivity. Newly developed high yielding varieties and related package of practice proved beneficial in increasing fodder yield through

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enhancement in productivity. Keeping this in view, 144 front-line demonstrations were conducted on three new varieties (SKO-20;SKO-91;SKO-96) of fodder oat and related crop management (Improved Practice) during the *rabi* seasons of 2017-18 to 2021-22 in farmers' participatory mode. The study revealed that Improved practice gave an additional yield of 66.6 q $ha^{-1,}$ of green fodder and yield (432.4 q ha^{-1}) was 18.4 % higher in than farmers' practice (63.9 q ha^{-1}). An extension gap of 66.6 q ha^{-1} and a technology gap of 67.6 q ha^{-1} were observed in the study. Net returns were Rs. 44359 ha^{-1} in farmers practice against Rs.52470 ha^{-1} in improved practice. An additional income of Rs. 7981 ha^{-1} and effective gain of Rs. 6293 ha^{-1} were recorded in improved practice.

Keywords: Fodder; farmers' participatory demonstrations; Himalayan ecosystem.

1. INTRODUCTION

According to the 20th livestock census of government of India, the total livestock population in rural and urban area is 514.11 million and 22.65 million respectively with percentage share of 95.78% for rural and 4.22% for urban area. (Anonymous 2019). Despite the fact that country is bestowed with huge animal resources, the productivity remains very low compared to the developed countries due to low availability of nutritious feed and fodder, especially with respect to the milch animals (Patel et al. 2011). The situation is no different in the union territory of Jammu & Kashmir where the deficit in fodder availability is a great challenge. In the temperate Kashmir valley a long lean period is experienced during winter from the month of December to ending February (Jehangir et al. 2013a). No green fodder is available to the cattle and the pastures (both alpine and sub-alpine) are also mostly inaccessible (Jehangir et al. 2013b). The only available fodder for the livestock in winter is paddy straw and maize stover, which are very low in nutritive value. This drastically reduces the milk and meat production in the valley. Due to shrinking agriculture land and land diversification, there are less chances for occupying more area under fodder crops. The only way out seems to be making efforts to increase productivity at farmers' field. Researchers report that there exits huge gap between the potential yield and the yields obtained at farmers' field and technology demonstration is instrumental in bridging the yield gaps in the hills (Sheikh et al. 2013, Mubarak and Shakoor 2019, Mubarak et al. 2023). Moreover, farmers' participation plays a key role in increasing the probability of adoption of new varieties and addresses the issue of selection efficiency in participatory plant breeding by testing the effect of selection environment on the performance of genotypes (Ceccarelli et al. 2003). In view of above and with the objective to popularizing new varieties with high yield potential and assess yield gaps, multiple frontline demonstrations were carried out in farmers' participatory mode. Front-line demonstrations technology transfer (FLD-TTP) is an adoptive research programme under ICAR, Ministry of Agriculture and farmers' welfare, government of India. These FLD-TTPs are carried-out under the supervision of scientists from National Agricultural Research System. At grassroots level, the programme is executed by Farm Science Centres popularly known as Krishi Vigyan Kendras in collaboration with concerned research centres and line department, across the country.

2. MATERIALS AND METHODS

A detailed survey of the 16 adopted villages (Table 1 and Fig. 1) located in the lap of Peer Panchal Himalayan Range in district Kulgam, which represents almost all the ecologies of the temperate Kashmir valley from high attitudes to lower plains, was conducted in *Kharif* 2017 to ascertain different factors responsible for low fodder production at farmers' field. The information was collected through face to face interaction and questionnaire designed for the purpose. Based on survey, improved practice (IP), which included latest high yielding fodder oat varieties and related crop management (Table 2) were selected for the demonstrations at farmers field against the existing farmers' practice (FP), which included old variety (Kent/sabzar) and tradition crop management. One hundred forty four (144) number of demonstration programs sponsored by ICAR-Agricultural Technology Application Research Institute Zone were conducted by Farm science center(KVK)-Kulgam over an area of 57.75 hectare from *rabi* 2017-18 to 2021-22 (Table 3). Each demonstration occupied 1 acre area (0.5 acre under Improved practice and 0.5 acre under Farmers' practice). Green fodder yield at flowering stage was recorded using quadrants randomly at three places each for farmers' and

improved practice and means registered as final yield data for statistical analysis. Economics was recorded based on the prevailing market rates of each year. Additional gains, effective gains, extension gap, technology gap and technology Index were calculated by using formulae given below;

- Additional gains (Rs. ha^{-1}) = Net returns (Rs.ha^{-1}) from Improved practice – Net returns(Rs. ha^{-1}) from farmers' practice
- Effective gains (Rs.ha^{-1}) = Additional returns (Rs.ha^{-1}) - additional costs (Rs. ha^{-1})
- Extension gap (q ha^{-1}) = Improved practice yield (q ha^{-1}) - farmers' practice yield (q ha^{-1}).
- Technology gap (q ha^{-1}) = Potential yield (q ha^{-1}) - Yield in demonstrated technology (q ha^{-1})
- Technology Index (%) = (Potential yield – Demo yield) / Potential yield) X 100

The yield data recorded were subjected to statistical analysis through student's t -Test using excel data analysis tool and means compared at $p \leq 0.05$.

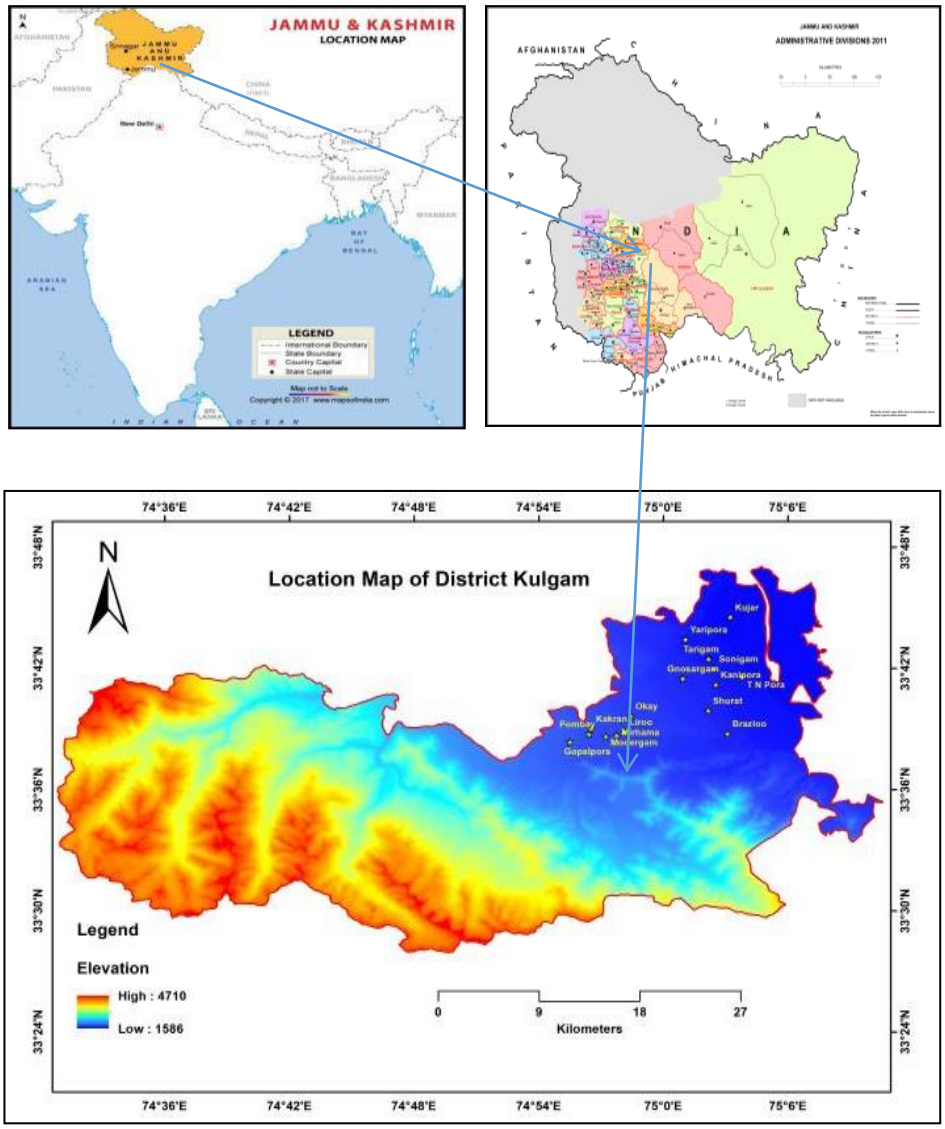

Fig. 1. Map of the study area

Table 1. List of villages covered under demonstrations

S/No	Name of Village	S/No	Name of Village
1	Tarigam	9	Kanipora
2	Pombay	10	Liroo
3	Sonigam	11	Kujar
4	Yaripora	12	Brazloo
5	Kakran	13	Modergam
6	Gopalpora	14	Shurat
7	T N Pora	15	Gnosargam
8	Okay	16	Mirhama

Table 2. Details of farmers' practice and improved practice

Input/operation	Farmers practice (FP)	Improved practice (IP)
1. Variety	Kent /sabzar	SKO-20;SKO-91;SKO-96
2.Seed rate (Kg ha^{-1})	150-200	100
3.Seed sowing	From 2nd week of October to-15th November	Between 1st and 15th of October
4.Fertilizer dose in Kg (N,P_2O_5,K_2O)	Haphazard (Range of N,P_2O_5 & K_2O application : 100-220, 15- 45 and 0-30 Kg ha^{-1}, respectively and average N,P_2O_5 & K_2O @ 163:27.3: 16.32 Kg ha^{-1}	150:60:40
5.Time of fertilizer application	Basal application of P and K fertilizer and application of N in two splits (I/2 basal and 1/2 in 1st week of March)	N application was 1/3rd basal, 1/3rd in the first week of March and 1/3rd at late jointing stage.

3. RESULTS AND DISCUSSION

3.1 Green Fodder Yield

Data pertaining to the green fodder yield are presented in Table 3. Improved practice registered significantly higher grain yield compared to the existing farmers practice during all the five years of study (Table 3 & Figs. 2 to 6). Yield ranged between 343 to 389 q ha^{-1} and 412 to 475 q ha^{-1} in farmers' practice and improved practice, respectively. Improved practice gave an additional yield of 66.6 q ha^{-1}on an average basis (Table 3). Crop yield (432.4 q ha^{-1}) was 18.4 % higher in improved practice compared to farmers' practice (63.9 q ha^{-1}). As evident from the Figs. 2-6 yield varied between the years of demonstrations. This may be attributed to the variation in weather parameters during the respective years. Moreover, the yield variation between the farmers' practice and improved practice may be attributed to new varieties possessing higher yield potential and better crop management adopted for improved practice. Similar findings were also reported by Patil et al. (2018) and Mubarak and Shakoor (2019). Per cent increase in yield showed a lot of variation over the years of study, ranging from 10.0% in 2018-19 to 26.3% in 2017-18. This indicated a varying response of two practices to the environment prevailing during the respective years of study. These findings are in line with those of Singh et al. (2015), Asif et al. (2017), Kaur et al. (2024) and Reddy et al. (2024).

3.2 Gap Analysis

Yield gap analysis revealed that extension gap ranged between 38 to 99 q ha^{-1} (Table 3) with average value of 66.6 q ha^{-1}. The Technology gap varied between 25 to 102 q ha^{-1} with an average value of 67.6 q ha^{-1}. These figures indicate that there is still scope to enhancing production in the valley by popularizing the latest high yielding varieties along with packge of practices. This can be achieved through collaborative efforts of extension functionaries involving Farm Science Centers (KVKs) and line department. Earlier Mubarak et al. (2013) and Sheikh et al. (2013) also reported similar results during their studies on demonstration of technologies under Kashmir valley conditions. Technology Index also varied between 5.0 to 20.4% with an average value of 13.52%. Since

technology index is an indicator of the feasibility of the evolved technology at the farmers' fields, so lower value of technology index would mean more feasibility of the technology. Technology index of 13.52% indicates that there is scope for further improvement in fodder oat productivity in Valley. These findings are in line with those of Mitra et al. (2014) and Singh et al. (2015).

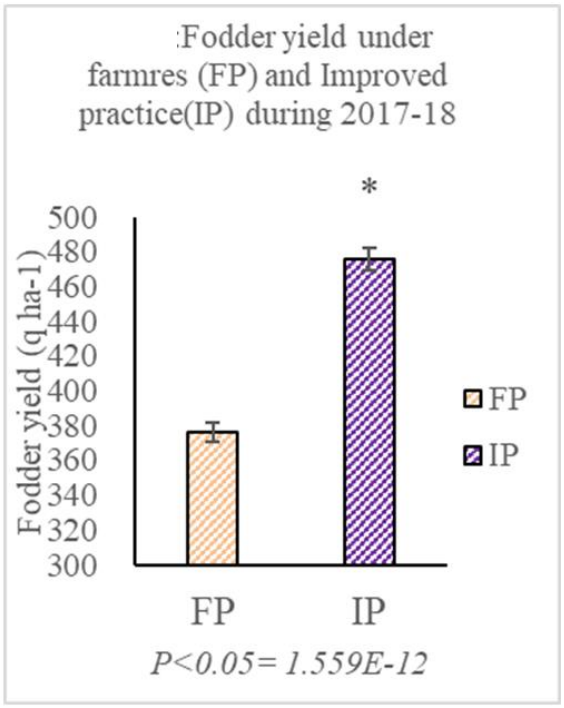

Fig. 2. Fodder yield under farmers (FP) and improved practice (IP) during 2017-2018

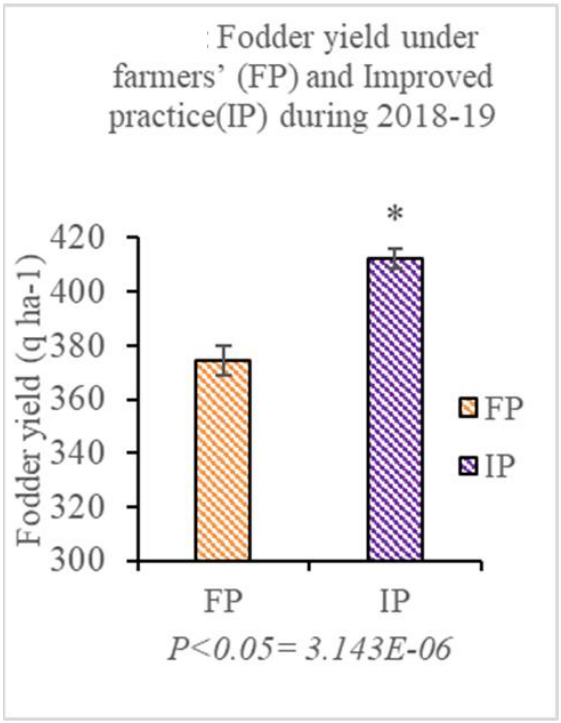

Fig. 3. Fodder yield under farmers (FP) and improved practice (IP) during 2018-2019

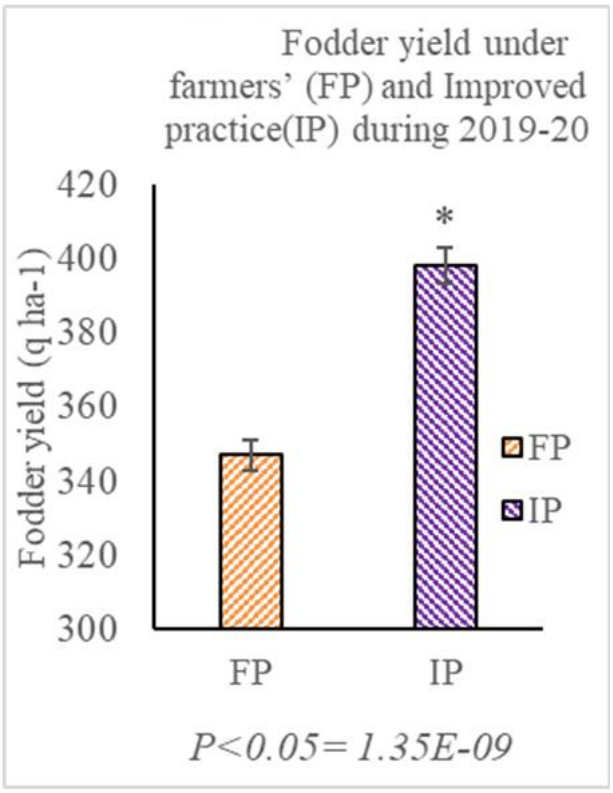

Fig. 4. Fodder yield under farmers (FP) and improved practice (IP) during 2019-2020

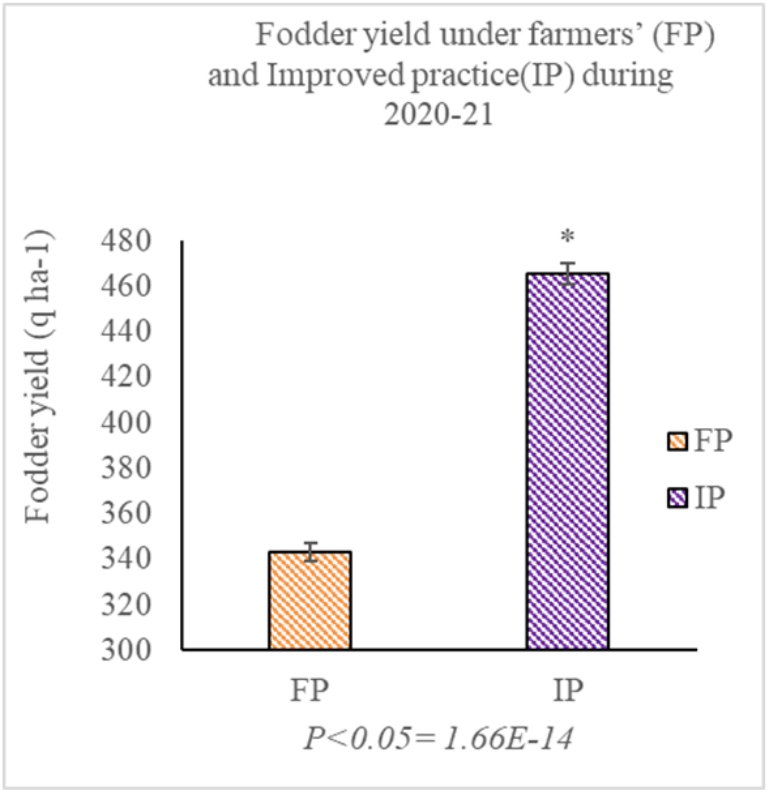

Fig. 5. Fodder yield under farmers (FP) and improved practice (IP) during 2020-2021

Table 3. Crop yield, gap analysis and technology Index under demonstration on fodder oat at farmers' field

Year		Area covered (ha)	Crop yield (q ha^{-1})		Extension gap	% increase in yield	Technology Gap	Technology Index
			Farmers Practice (FP)	Improved Practice (IP)				
2017-18	50	20	376	475	99	26.3	25	5
2018-19	54	21.6	374	412	38	10.0	88	17.6
2019-20	19	7.75	347	398	51	14.6	102	20.4
2020-21	11	4.4	389	465	76	19.5	35	7
2021-22	10	4	343	412	69	20.1	88	17.6
Total/Mean	144	57.75	365.8	432.4	66.6	18.4	67.6	13.52

Table 4. Economic Analysis of frontline demonstration programme on fodder oat at farmers' field

Year	Input cost (Rs.ha^{-1})		Additional cost in IP	Gross returns (Rs. ha^{-1})		Net returns (Rs. ha^{-1})		Additional returns from IP (Rs ha^{-1})	Effective Gain from IP (Rs)	B:C ratio	
	FP	IP		FP	IP	FP	IP			FP	IP
2017-18	22500	23500	1000	64190	73938	41690	50438	7898	7748	0.9	1.1
2018-19	24320	26050	1730	66100	71800	41780	45750	3970	2240	0.7	0.8
2019-20	25258	27320	2062	67255	75670	41997	48350	6353	4291	0.7	0.8
2020-21	27401	29451	2050	77800	93000	50399	63549	13150	11100	0.8	1.2
2021-22	26700	28950	2250	72630	83217	45930	54267	8537	6087	0.7	0.9
Average	25235.8	27054.2	1818.4	69595	79525	44359.2	52470.8	7981.6	6293.2	0.8	0.9

FP=Farmers Practice; IP= Improved Practice

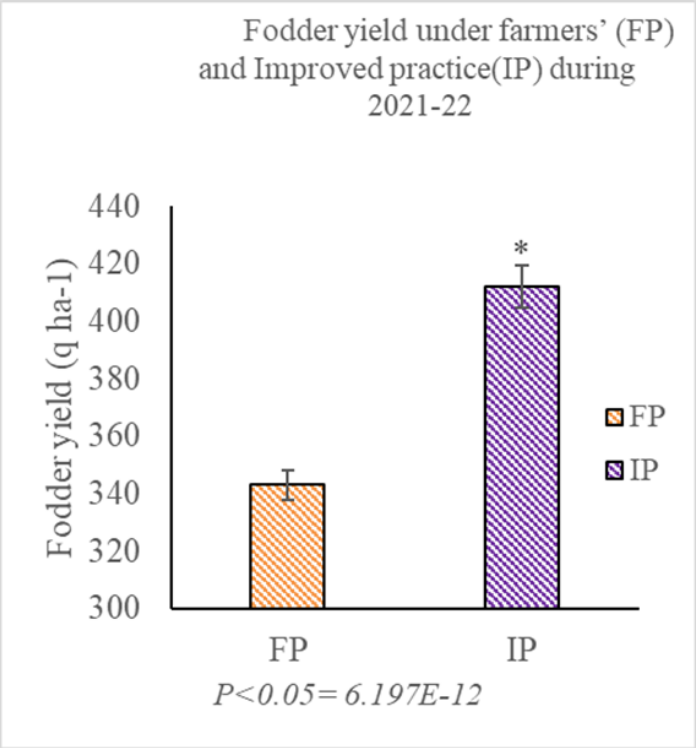

Fig. 6. Fodder yield under farmers (FP) and improved practice (IP) during 2021-2022

3.3 Economic Impact

Economics varied during different years of study both in the improved technology and farmers practice (Table 4). The input costs ranged between ₹22500 ha^{-1} in year 2017-18 in farmers' practice to Rs.29451 ha^{-1} in the improved practice in year 2020-21. This was due to variation in cost of inputs in different years of study and comparatively higher inputs utilized in the improved practice. On an average the cost of inputs was Rs.25235 ha^{-1} and Rs.2754 ha^{-1} for farmers practice and improved practice, respectively. Improved practice involved an additional cost of cultivation of Rs.1818 ha^{-1}. Gross and net returns fluctuated during the years of study with maximum values recorded for improved practice (Table 4). On an average gross returns registered under farmers practice and improved practice were Rs. 69595 and Rs. 79525ha^{-1}, respectively. Net returns were Rs. 44359 ha^{-1} in farmers practice against Rs.52470 ha^{-1} in improved practice. An additional income of Rs. 7981 ha^{-1} and effective gain of Rs. 6293 ha^{-1} were recorded in improved practice. Benefit: cost ratio (0.9) was also high in improved practice compared to farmers practice (0.8). The additional returns, effective gain and higher net returns obtained under improved practices may be attributed to high yield potential of new varieties under good crop management.

4. CONCLUSION

Fodder scarcity during winters is one of the great challenges the Union territory of Jammu & Kashmir has been facing in the past and at present. The situation in this regard demands increase in fodder production through all possible means. Increasing productivity at farmers' field is one of the solutions to meet the deficit. This study shows that technological interventions in-terms of new varieties with high yield potential and good crop management can help in achieving higher productivity and increase fodder production. Thus adopting improved practices over traditional practice not only increases fodder production but also improves farm income.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) have been used in this study.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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