



## Feed technology research platform Patancheru, India

The Feed Technology Research platform located at the ICRISAT campus in Patancheru, India is part of the Feed and Forage Development program of the International Livestock Research Institute (ILRI). The platform supports ILRI work in Asia and East and West Africa under the CGIAR Research Programs on Livestock (Livestock CRP), Grain Legume and Dryland Cereals (GLDC) and numerous bilateral projects.

Key research areas of the platform are:

(1) Developing tools that can rapidly and affordably analyze fodder quality, generate feed demand and supply information and formulate balanced least cost rations;

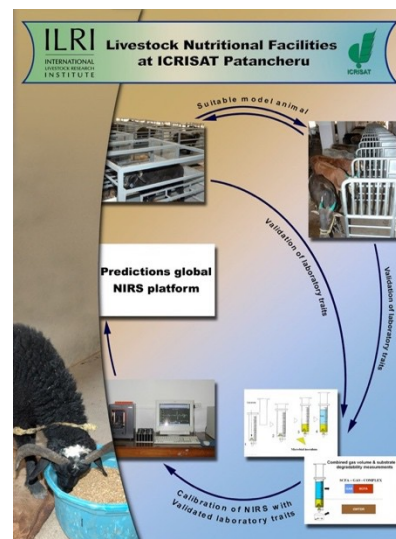
2) Increasing the availability of quality feed biomass from forages and crop residues;

3) Making better use of existing feed resources through feed processing, preservation and supplementation options; and

4) Developing and supporting feed and fodder value chains.

- ILRI's only lab in South Asia with an advanced feed evaluation facility equipped with stationary, mobile and hand-held NIRS spectroscopy tools
- Phenotyping of a wide range of laboratory food and feed quality parameters in between 15,000 and 33,000 feed samples every year
- Confirm and validate laboratory feed quality parameters by animal performance trials

- Collaborative work with national (NIANP, NRRI, IIMR, EIAR) and international (ICRISAT, CIMMYT, IRRI) crop centres on 'full purpose crops' using conventional and molecular breeding techniques
- Field piloting with state government departments (Karnataka, Odisha) to improve the basal diet of animals through dual purpose cultivars, feed processing and balancing
- Works on converting roughages into concentrates using 2<sup>nd</sup> Generation biofuel technologies
- Engagement in feed value chains to increase the availability of off farm produced feed and to generate income and employment in feed and fodder value chains



## Infrastructure facilities at the feed platform

1. Wet laboratory: the conventional wet laboratory has facilities for all proximate analysis of dry matter, organic matter, crude protein and fibre fraction estimations.



2. In vitro laboratory: has 300 fermentation vessels for analysis of apparent and true in vitro digestibility, rate of fermentation and partitioning of rumen degradation products allowing estimation of methane production in vitro.



3. NIRS laboratory: the feed platform has been equipped with stationary (FOSS 5000, 6500 and XDS RCA), mobile and handheld NIRS technologies (Brimrose, Thermo, TellSpec and Scio). The platform had developed more than 70 global NIRS equations for feed and food traits. The platform supports NIRS use and hub formation, as well as training in NIRS technologies, for Asia and a range of countries in East and West Africa. It also assists CGIAR centres, NARES and the private sector.



4. In vivo experimental facility: this facility has metabolic cages designed for conducting individual animal performance measurements in 60 small ruminants and 24 large ruminants.



5. Experimental feed processing unit: this unit has feed processing facilities to make total mixed rations in the form of block, mash and expander extruded pellets. The capacity of the block and expander extruded pellet making machine is 100 kg/h and 500 kg/h, respectively whereas the capacity of mash making (chopper-cum-grinder) unit is 200–250 kg/h.





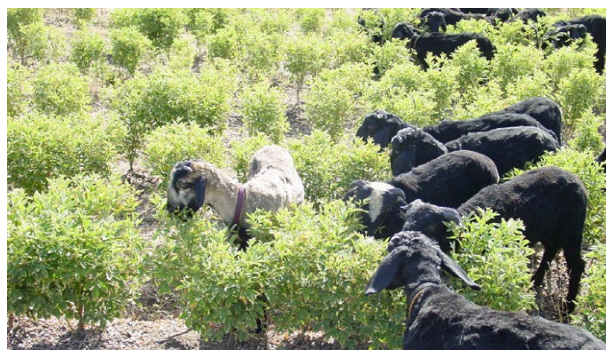
## Partnerships

The platform works with a range of national and international public and private sector partners to meet the four key research activities. In tool development, ILRI works with the National Institute for Animal Nutrition and Physiology in India, the Agricultural Transformation Agency in Ethiopia and the Hone Company in Australia. Research on increasing availability of quality biomass is undertaken in partnership with ICRISAT, CIMMYT and IRRI; the Indian Institute for Millet Research (IIMR); the National Institute for Rice Research (NRRRI) in India; the Ethiopian Institute of Agricultural Research (EIAR) in Ethiopia; and other key private sector players such as Advanta, Syngenta and Hatsun. Making better use of existing feed resources engages the private sector such as Fertile Green Inc. in India, EthioFeed in Ethiopia and NGOs, cooperatives and state extension services.

## Publications in 2019 derived from platform research

### Journal articles and invited papers

1. Anandan, S., Angadi, U.B., Khan, A.A., Ramakrishna, C.H., Ravi, D., Prasad, K.V.S.V. and Blümmel, M. 2019. Embracing whole plant optimization of rice and wheat to meet the growing demand for food and feed. *Field Crops Research* 244:107634. <https://doi.org/10.1016/j.fcr.2019.107634>
2. Angadi, U.B., Animut, G.A., Anandan, S., Blümmel, M., Moyo, S., Rahman, H. and Jones, C. 2019. *Feed Base-Ethiopia: database and decision-making tool for supply and demand of livestock feed resources in Ethiopia*. South-South Development Co-operation for Food Security (Proceedings in press).
3. Blümmel, M., Anandan, S., Zaidi, P.H., Vadez, V., Ramana Reddy, Y. and Pasupuleti, J. 2019. *Multidimensional crop improvement by ILRI and partners: Drivers, approaches, achievements and impact*. CABI Publishing (in press).
4. Blümmel, M., Prasad, K.V.S.V., Ravi, D., Ramakrishna, Ch., Padmakumar, V., Seetharama, N., Tonapi, V. A. and Bhat, V. 2019. Multi-trait improvement in sorghum to optimize livelihoods from mixed crop livestock systems and the impact of augmented new cultivar release criteria. In: *Sorghum in the 21st Century: Food, Feed and Fuel for a Rapidly Changing World*. Springer Verlag (in press).
5. Blümmel, M., Sudharakan, D.S., Sharma, G.V.M., Ravindranath, K. and Padmakumar, V. 2019. *Spin-off technologies from 2nd generation biofuel: potential game changers for upgrading cereal straws and stovers for livestock feed in India*. Summary-Lead and Session Lectures 2019. XIV Agricultural Science Congress on Innovations for Agricultural Transformation, pp. 1–170, New Delhi, India: NAAS and ICAR-IARI. (in press).



6. Blümmel, M., Upadhyaya, S.R., Gautam, N., Barma, N.C.D., Abdul Hakim, M., Hussain, M., Mujahid, M.Y., Chatrath, R., Sohu, V.S., Mavi, G., Mishra, V.K., Kalappanavar, I.K., Naik R., Biradar, S., Prasad, S.V.S., Singh R.P. and Joshi, A.K. 2019. Comparative assessment of food-fodder traits in a wide range of wheat germplasm for diverse biophysical target domains in South Asia. *Field Crops Research* 236: 68–74. <https://doi.org/10.1016/j.fcr.2019.03.001>.
7. Duncan, A.J., Arindam S. and Blümmel, M. 2019. Rice and wheat straw fodder trading in India: possible lessons for rice and wheat improvement. *Field Crops Research* 246: 107680. <https://doi.org/10.1016/j.fcr.2019.107680>
8. Govintharaj, P., Shashi, K.G., Blümmel, M., Maheswaran, M., Sumathi, P., Roma, R.D. and Rathore, A. 2019. Utilization of molecular marker based genetic diversity patterns in hybrid parents to develop better forage quality multi-cut hybrids in pearl millet. *Agriculture* 9 (97). <https://doi.org/10.3390/agriculture9050097>
9. Joshi, A.K., Barma, N.C.D., Abdul Hakim, M., Kalappanavar, I. K., Naik R., Suma S.B., Prasad, S.V.S., Singh, R.P. and Blümmel, M. 2019. Opportunities for wheat cultivars with superior straw quality traits targeting the semi-arid tropics. *Field Crops Research* 231: 51–56. <https://doi.org/10.1016/j.fcr.2018.10.015>
10. Joshi, A.K., Ravi, S., Ramesh, C., Suma, S.B., Ravish, C., Neeraj, B., Rudra, N., Uttam, K., Vinod K.M. and Blümmel, M. 2019. Variations in straw fodder quality and grain–straw relationships in a mapping population of 287 diverse spring wheat lines. *Field Crops Research* 243: 107627 <https://doi.org/10.1016/j.fcr.2019.107627>

11. Noriega, I.L., Halewood, M., Abberton, M., Amri, A., Angarawai, I.L., Anglin, N., Blümmel, M., Bouman, B., Campos, H., Costich, D., Ellis, D., Gour, P.M., Guarino, L., Hanson, J., Kommerell, V., Kumar, L., Lusty, C., Ndjiondjop, M., Payne, T., Peter, M., Popova, E., Prakash, G., Sackville-Hamilton, R., Tabo, R., Upadhyaya, H., Yazbek, M. and Wenzel, P. 2019. CGIAR Operations under the Plant Treaty Framework. *Crop Science* 59 (3): 819–832 <https://doi.org/10.2135/cropsci2018.08.0526>
12. Padmakumar, V., Mckune, S., Miller, L., Hendrickx, S., Mulubrhan, B., Dahl, G.E. and Adesogan, A.T. 2019. Sustainable livestock systems to improve human health, nutrition, and economic status. *Animal Frontiers* 9 (4): 39–50. <https://doi.org/10.1093/af/vfz041>
13. Ramakrishnan, M.N., Rajkumar, R.G., Venkata, N.B., Prasad, K.V.S.V., Ravi, D. and Blümmel, M. 2019. Variation in grain yield, fodder quality and animal intake in two dual purpose legume crops: Mungbean and vegetable soybean grown in semi-arid tropical India. *Legumes Research* <https://doi.org/10.18805/LR-4078>
14. Ramana Reddy, Y. and Blümmel, M. 2019. Options for enhancing sorghum forage utilization in ruminants. In: *Sorghum in the 21st Century: Food, Feed and Fuel for a Rapidly Changing World*. Springer Verlag (in press).
15. Ravi, D., Subba Rao, I.V., Jyothi, B., Sharada, P., Venkateswarlu, G., Ramakrishna, C.H., Prasad, K.V.S.V. and Blümmel, M. 2019. Investigation of fifteen popular and widely grown Indian rice varieties for variations in straw fodder traits and grain-straw relationships. *Field Crops Research*. 243: 107627 <https://doi.org/10.1016/j.fcr.2019.107627>
16. Subudhi, H.N., Prasad, K.V.S.V., Ramakrishna, C.H., Rameswar, P.S., Pathak, H.K., Ravi, D., Khan, A.A., Padmakumar, V. and Blümmel, M. 2020. Genetic variation for grain yield, straw yield and straw traits in 132 diverse rice varieties released for different ecologies such as upland, lowland, irrigated and salinity prone areas in India Journal. *Field Crops Research* 245: 107626. <https://doi.org/10.1016/j.fcr.2019.107626>
17. Virk, P., Xianglin, L. and Blümmel, M. 2019. A note on variation in grain and straw fodder quality traits in 437 cultivars of rice from the varietal groups of aromatic, hybrids, Indica, new planting types and released varieties in the Philippines. *Field Crops Research* 233: 96–100. <https://doi.org/10.1016/j.fcr.2018.12.007>
2. Blümmel, M. and Jones, C. 2019. Lipid enrichment in crops residues: a possible strategy to improved feed value. 8<sup>th</sup> Asian-Oceania Symposium on Plant Lipids, 19–22 November 2019, Canberra. (Proceedings in press)
3. Blümmel, M., Sharma, G.V.M., Ravindranath, K., Padmakumar, V. and Jones, C. 2019. Spin-off technologies from 2nd generation biofuel: potential to transform fodder quality of crop residues. Ethiopian Society of Animal Production, Conference Proceedings (in press).
4. Choudhary, S., Kholova, J., Chadawada, K., Srikanth, M., Prasad, K.V.S.V., Amol, N.N., Ravi P.S., Krithika A., Vania, A., Vadez, V. and Blümmel, M. 2019. NIR spectroscopy: the gateway to physiology of nutritional traits of crops. Nir2019, Gold Coast, Queensland 15–20 September (proceedings in press).
5. Kholova, J., Choudhary, S., Srikanth, M., Prasad K.V.S.V., Vadez, V. and Blümmel, M. 2019. Improving post-rainy sorghum to meet the growing grain and fodder demand in India. nir2019, Gold Coast, Queensland 15–20 September (proceedings in press).
6. Nouhoun, Z., Augustine, A., Prasad, K.V.S.V., Blümmel, M., Dubex, J. and Adegbola, A. 2019. Forage production and nutritive value of brachiaria hybrid cv. “mulato II”, brachiaria ruziziensis and megathyrus maximus cv. “CI” as influenced by planting methods in sub humid zone of west africa. The joint international grassland and international rangeland congress (abstract accepted id: igc-irc20201031)
7. Prasad, K.V.S.V., Asmare, Y., Adey M.Y., Kosmowski, F., Padmakumar, V. and Blümmel, M. 2019. Mobile and hand-held near infrared spectrometers in feed evaluation – solutions to challenges? In: Asit Das, Srinibas Das, Srobana Sarkar, A. K. Patra, G. P. Mandal and S. Soren (eds), *Nutritional Strategies for Improving Farm Profitability and Clean Animal Production*. Book of Abstracts of International Conference on Animal Nutrition, December 17–19, 2019. Kolkata, West Bengal: India: p. 333.
8. Prasad, K.V.S.V., Ramakrishna Reddy, Ch., Ramana Reddy, Y., Padmakumar, V. and Blümmel, M. 2019. Use of near infrared reflectance spectroscopy (NIRS) to profile fatty acids of feeds and forages. In: Asit Das, Srinibas Das, Srobana Sarkar, A. K. Patra, G. P. Mandal and S. Soren (eds), *Nutritional Strategies for Improving Farm Profitability and Clean Animal Production*. Book of Abstracts of International Conference on Animal Nutrition, December 17–19, 2019. Kolkata, West Bengal: India: 334pp.
9. Ravi, D., Blümmel, M., Prasad, K.V.S.V., Khan, A.A., Shiva, R. and Padmakumar, V. 2019. Are Commercial Total Mixed Rations Viable in Intensifying Sheep Production? In: Asit Das, Srinibas Das, Srobana Sarkar, A. K. Patra, G. P. Mandal and S. Soren (eds), *Nutritional Strategies for Improving Farm Profitability and Clean Animal Production*. Book of Abstracts of International Conference on Animal Nutrition, December 17–19, 2019. Kolkata, West Bengal: India: p. 52.
10. Thanammal, R., Blümmel, M. and Teufel, N. 2019. Factors influence adoption of perennial forage varieties in dairy production system in india. In: Asit Das, Srinibas Das, Srobana Sarkar, A.K. Patra, G.P. Mandal and S. Soren (eds), *Nutritional Strategies for Improving Farm Profitability and Clean Animal Production*. Book of Abstracts of International Conference on Animal Nutrition, December 17–19. Kolkata, West Bengal: India: p. 322

## Abstracts and conference proceedings

- I. Anil, G., Blümmel, M., Santosh, P.D., Prasad, K.V.S.V., Chavan, U.D., Kavi Kishore, P.B., Rahul, M.P., Jayakumar, J., Sunita, G. and Ashok Kumar, A. 2019. Standardizing the near-infrared spectroscopy (NIRS) for low-cost high throughput assessing of phytate and polyphenol contents in sorghum grain. 1<sup>st</sup> National Genetics Congress. New Delhi, India.

11. Thanammal, R., Vinod Kumar, M., Teufel, N. and Blümmel, M. 2019. The impact of perennial forage varieties in milk productivity and gender role. In: Asit Das, Srinibas Das, Srobana Sarkar, A.K. Patra, G.P. Mandal and S. Soren (eds), *Nutritional Strategies for Improving Farm Profitability and Clean Animal Production*. Book of Abstracts of International Conference on Animal Nutrition, December 17–19. Kolkata, West Bengal: India: p. 137.
12. Vinutha, K.S., Prasad, K.V.S.V., Ravi, D., Anilkumar, V., Sivasubramani, S., Abhishek, R., Blümmel, M. and Deshpande, S.P. 2019. Identification of putative genomic regions for fodder quality traits in sorghum. VI next generation genomics and integrated breeding for crop improvement conference on crop genomics: present and future. Poster No:CG4-P013, p. 90.

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