Pasture Production and Grazing System in ASSIST Project: Outcome and replication viability in Nigeria for sustainable ruminant production

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Abstract
As important as pasture is to productive management of cattle, sheep and goats, intensive development of grassland for ruminant animals is rare in Nigeria largely due to no conscious effort at pasture cultivation in the country. Consequently, nomadic and free grazing systems remain a practice in the country, with resultant poor animal productivity and agro-related conflicts between ruminant keepers and crop farmers and/or agro-processors. The need to revert this situation underscored the exploration of the potential value of the innovative pasture production and grazing management system tested under the Achieving Sustainable Agricultural Systems (ASSIST) programmme in Rothamsted Research, United Kingdom, for application in Nigeria. The project, which cultivated swards of different species such as permanent pasture, grass mix ("soft fibre" cultivars) and multispecies swards, was managed as continuous stocking orcell-rotational grazing systems under drained and undrained soil conditions. Conscientious management and weekly monitoring of the pasture, using calibrated plate-meter, not only made it possible to ensure adequate herbage availability to the reared ruminants but also enhanced productive performance of the farm animals. Although, the common types of swards in Nigeria differ from that of ASSIST project, a modified application of the paddock development model could enhance quality paddock development in the country for sustainable grazing and productive ruminant management.

Keywords: Paddock development, quality swards, innovative management, rotational grazing, sustainable production, Nigeria

Introduction
Ruminant animal production is a major farm product in Nigeria for both economic and nutritional purposes. According to Lebbie, (2004) and Paulina et al, (2017), sustainable ruminant production is crucial to feeding the planet and supporting economies of individuals involved in ruminant production and the dressing value chain. In the continent of Africa, Nigeria has the largest ruminant herd (LiveGAPs, 2020), with population estimate of about 20.7 million cattle, 42.5 million sheep and 80.8 million goatsas at 2012, with a projected increase to 53.6 million cattle, 78.2 million sheep and 207.8 million goats by 2050 (FAO, 2019). In as much as the projected increase in ruminant population could be a guaranteed increase in animal-source nutrition for the Nigerian population, the current challenge of inadequate pasture production for the animals may mar the expectation. This is based on the current dependence of ruminant grazing on naturally occurring pasture with little or no effort at deliberate pasture cultivation in the country. This practice has greatly hindered productive ruminant animal production (Proshare, 2019) alongside escalation of social conflicts between ruminant herders and farmers (Lawal-Adebowale, 2018). The need to avert this situation calls for conscious and conscientious pasture cultivation in the country as

practicedin the developed countries (Marzban & Valizadeh, 2020). To achieve the goal of pasture production in Nigeria, this article takes a look at theattained innovative pasture production for productive ruminant management in Rothamsted Research, Southwest of England for replication in Nigeria with a view to attaining sustainable pasture production in the country.

Grassland development in Rothamsted Research: The research design

The research programme, termed Achieving Sustainable Agricultural Systems (ASSIST), aimed at ensuring sufficient pasture production for sustainable sheep and cattle production throughout the grazing season. The projecttested production of three sward types, i.e. a permanent pasture, a mix of grass cultivars selected for highly digestible fibre ("AgriTech") and multispecies swards, comprising grasses, legumes and forbs ("Nature-based") (Figure 1). The pastures, cultivated under drained and undrained soil conditions, were managed as continuous stocking orcell-rotational grazing systems. The permanent pasture mainly consists of *Lolium perenne*; the AgriTech sward consists of*Festulolium* and *L. perenne* cultivars, with the Nature-based consisting of a mixture *Festuloliumloliaceum, L. perenne, Dactylis glomerata, Phleum pratensis, Trifolium pratensis, T. repens, T. hybridum, Lotus curniculatus, Medicago lupulina, Sanguisorba minor, Achillea millefolium, Plantago lanceolate* and *Cichorium intybus*. While the permanent pasture and the AgriTech swards were fertilized with inorganic fertilizer at the rate of 40kg N/ha per month between April and July 2019 (to give 160kg N/ha per year), the Nature-based received no fertilizer. For sustainable feeding of the stocked sheep, the project proposes average herbage cover of about 1800 – 2000kg DM ha^{-1} under the continuous stocking management and between i500 and 2200 kg DM ha^{-1} under the AgriTechgrazing management. Where the grass is below the proposed herbage cover, the stocking rate becomes reduced, and where it is more than the proposed herbage cover, the rotation period becomes extended with a view to ensuring stabilized grazing management.

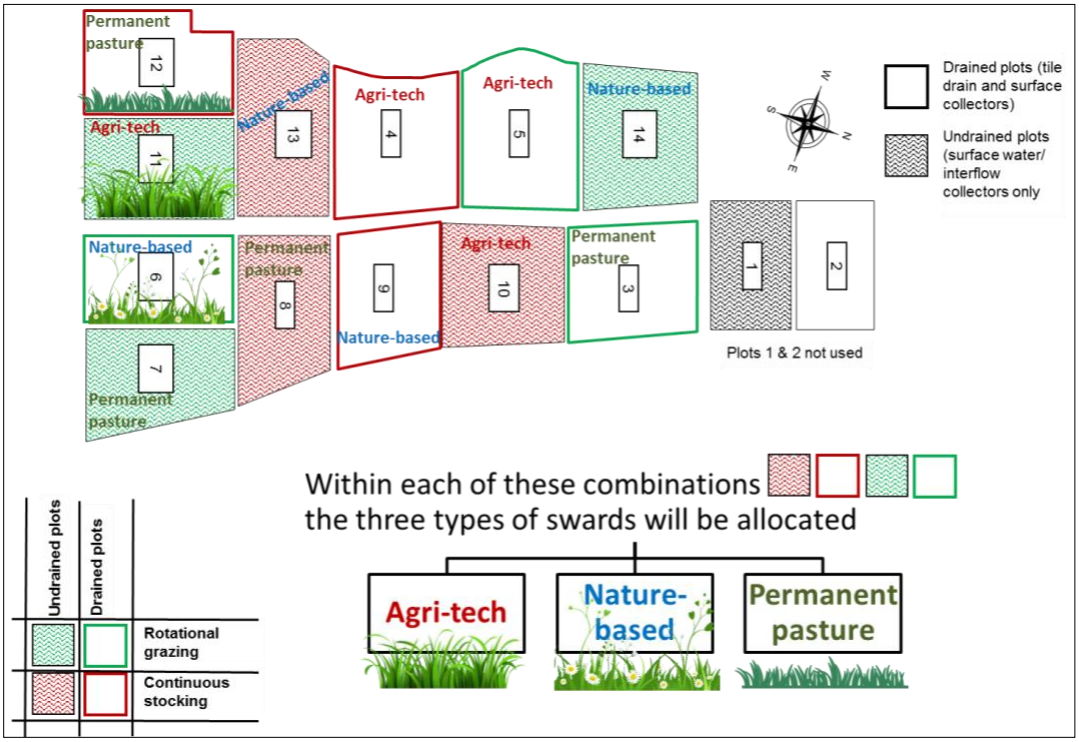

Figure 1. Layout of the grazing experiment testing three types of cultivated swards under two grazing strategies for sheep.

Outcome of ASSIST research in 2019 grazing season

Weekly monitoring of grazed and re-emerged pasture for sufficiency, using the Rising Plate Meter (RPM) device, showed that the three types of raised paddock produced enough pasture for sufficient consumption by a population of 12 – 15 ewes and 24 – 30 lambs per hectare. Table 1 shows that the pre-grazing herbage cover for three types of paddock production systems in the cell-grazing averaged 2372 (SD = 586.4) under the drained soil condition, and 2657 (SD = 261.3) kg DM ha^{-1} under the undrained soil condition, at interval of 2 to 3 days of measurements, and up to 28 or 30 days of complete rotation. With the ewes and lambs consuming as much quantity of swards needed for body maintenance and production performance, the observed post-grazing herbage cover averaged 1772 (SD = 196.5), under the drained soil condition, and 2183 (SD = 196.5)kg DM ha^{-1}, under the undrained soil condition, at interval of 2 to 3 days of weekly measurement. In the same vein, the continuous stocking paddock maintained an average herbage coverof1978 (SD = 165.4)kg DM ha^{-1}, under the drained soil condition, and 1918 (SD = 284.7), under the undrained soil condition, at interval of 2 to 3 days of measurement, and all through a month. Assessment of weight gain by lambs across the paddocks, showed that the cell-rotational grazing produced more kg of lambs per ha than the continuous stocking (Rivero et al, 2020a) with similar growth rates between sward types and grazing strategies (Rivero et al., 2020b).

Table 1. Weekly herbage mass (kg DM ha^{-1}) of the three sward types in both drained and undrained plots and under cell-rotational grazing or continuous stocking.

Sward types	Cell grazing (herbage mass kg DM/ha)		Continuous stocking (herbage mass kg DM/ha)
	Pre-grazing	Post grazing	Grazed
Permanent			
Drained	2459	1935	2092
Undrained	2810	1853	1738
Agri-Tech			
Drained	1747	1554	1654
Undrained	2805	2115	1954
Multispecies sward			
Drained	2910	1828	2188
Undrained	2355	2581	2063
Mean			
Drained	2372 (SD = 586.4)	1772 (SD = 196.5)	1978 (SD = 284.7)
Undrained	2657 (SD = 261.3)	2183(SD = 368.7)	1918 (SD = 165.4)

Implication of the ASSIST pasture production model for the Nigerian pasture development drive

The achieved sustainable pasture production for feeding of ruminants under the ASSIST paddock production model imply that pasture could be sustainably produced for productive ruminant management in Nigeria, and elsewhere in sub-Saharan Africa, if the needed production and policy supports are given by stakeholders in the country's livestock development system. Although, the surviving grass crop in the temperate region, as experimented with in Rothamsted Research, may not be fitting for the tropical region

of Africa, in Nigeria and other African countries are quality and environment-fitting pasture that could be conscientiously cultivated for confined grazing by ruminants. Notable grasses in this regard include Guinea grass (*Panicum maximum)*, Ruzi grass (*Brachiariaruziziensis*), Signal grass (*Brachiariadecumbens*); and legumes such as Caribbean Stylo (*Stylosantheshamata*), Common Stylo (*Stylosanthesguainensis*), Lablab (*Lablab purpureus*). The desired sustainable pastures production could however be attained with the institution of pro-ruminant development policy, backed-up with the political will for implementation and development, in the country (Qi et al, 2018). The essence of legume or forb integration is to improve the mineral and protein content of the multi-sward species (Zaralis, et al, 2016). Although agriculture practice and even pastures availability in Nigeria depend on rainy season, a field trial of the highlighted pasture and legumes in Federal University of Agriculture Abeokuta, Nigeria (FUNAAB), which is still ongoing, is most likely to produce the expected result of developing a confined grazing system in the country. The challenge of drought of pasture during the dry season however calls for pasture conservation to take care of the usual dry season shortfalls, as done under the ASSIST project, and/or in the developed countries. The outcome of this will not only ensure all-year-round availability of pasture to the ruminants but also enhance productivity of the animals (van den Pol-van et al, 2019) and elimination of the seasonal farmer-herder conflicts in the country.

Conclusions and recommendations

Based on the outcome of the pasture production system under the ASSIST project the study reflects the possibility of replicating the same practice in the Nigerian ruminant development drive. The success of the ASSIST project is based on conscientious efforts for ruminant development through sustainable pasture production. This informed the provisions of production resources, in terms of human and non-human resource, and pro-livestock (ruminant)-development policy with the political will for accomplishment of the task. The Nigerian, and possibly the African, livestock system could thus leverage on the success of the ASSIST pasture production project by putting up pro-livestock (ruminant)-development policy(ies) with the political will for its implementation. Alongside this is the need for re-orientation of the ruminant farmers, through extension education and advisory services, for adoption of conscientious pasture production and confined grazing. This action will certainly ensure all-year-round availability of pasture for sustainable ruminant feeding and improved productivity of the animals. This will as well halt the seasonal farmer-herder conflicts in the country.

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