**Original Research Article**

**Demonstration and Participatory Evaluation of Improved Forage Production in case of Shabeley District Fafan Zone, Somali Region**

# Abstract

*This experiment was conducted with the objective of evaluating and demonstration the productivity of the selected improved forage species and assessing pastoralists’ perception on the selected forage species and assessing pastoralist criteria for select forage species as livestock feed evaluated. Data on growth yield and yield related parameters were collected and analysed using SAS software. Accordingly, the result Panicum grass had significantly (P<0.05) early maturity than Sudan, Rhodes grass variety the biomass yield of Sudan was significantly higher than all the other grass species, in Sudan (12 t/ha) and Panicum (9t/ha) followed by Rhodes (6.7t/ha) and the maturity for Sudan Grass was significantly higher than the other species in (67 days). Where Sudan and Panicum Grass showed significantly higher plant height than the other grass types the highest plant height was recorded from Sudan grass (2.06m) followed by Panicum grass (1.75cm) and Rhodes (70cm) grass respectively.*

*Overall, the findings indicate that agro-pastoralists favour forage varieties that are high-yielding, palatable, quick-maturing, and, with moderate regard for drought tolerance and sustainable harvesting practices. These insights are valuable for breeding programs, policymakers, and extension services, as they clarify which traits should be prioritized in developing improved forage options. Future breeding initiatives should aim to select and promote forages that maximize productivity while remaining resilient to climate variability. According to the pastoralist perception ranked Sudan and Panicum were selected first and followed by Rhodes Grass respectively. According to the pastoralist perception criteria for their biomass palatability, drought tolerance and regeneration capacity. Sudan and Panicum showed higher biomass yield quality and performance; therefore, these grasses should be tested in different areas and disseminated to the community by creating awareness about proper management system*

***Key Words*:** *Dry matter yield; forage species, farmer perception. pairwise rank*

# INTRODUCTION

llivestock production is one of the most important agricultural land use systems in the world, with grasslands covering 25% of land surface and contributing to the livelihoods of more than 800 million people However, in Ethiopia livestock production has been mainly constrained by in adequate supply and poor quality of available feed resources. This could be further emphasized by the fact that feed accounts for 60–70% of the costs associated with livestock production. Nowadays, the most important livestock feed resources in Ethiopia are natural pasture, crop residues and grass hay. Natural pasture hay and crop residues which provide the bulk livestock feed in Ethiopia are seasonally produced during particular periods of the year (October–January) following the main rainy season. Excess forage production is experienced during the rainy season, but more often, acute shortages occur in the dry season as observed in some parts of the country. Most of ruminant livestock in Ethiopia rely on local grasses for their roughage and much of their nutrition. Many of the available local forage species have low palatability, poor productivity and inadequate nutrient supply to maintain animals, especially during the dry season. Improved forages have better productivity, palatability and nutrient characteristics that make them desirable for inclusion in improved forage production improvement program (Alemayehu, 2002) Livestock feeding is one of the most expensive inputs in livestock production, and the introduction and development of improved forage crops and the establishment of forage seed production could provide many economic opportunities for pastoralist/ agro-pastoralist which would improve their livelihoods, and increase their profitability. Establishing reliable forage production depends on the availability of reliable supplies of quality forage seeds/cuttings (Alemayehu, 1997) )and locally producing forage seed ensures sustainability and it is economical. Many different organizations are requesting seeds of different forage species. Even at a national scale, despite the presence of high demand, there is a critical shortage of forage seeds (MOARD, 2006; Kedir, 2008)

Somali regional state (SRS) is one of the administrative regions of Ethiopia, which is occupied by large population of pastoralists and Agro-pastoralists. The region has huge livestock potential and wide range of geographical coverage for livestock rearing (Alemayehu Mengistu (2002). According to the land use system in the region, livestock grazing and browsing constitutes about 44% (13,950,000 ha) of land mass (Alemayehu Mengistu (2002). Similar to the other pastoral areas of the country, livestock keeping has been the main practice of the Somali pastoral and agro-pastoral community who occupy almost all the rangelands of the SRS. Pastoralist is pre-dominant land use management system in the semi-arid and arid lands covering extensive areas of the rangelands in southern and south eastern part of the SRS. Due to different factors like seasonality, poor animal and human health, place enormous stress on the traditional pastoral and land management practices. As a result the productivity and economic contribution of the huge livestock population do not definitely much their number..

This study contributes significant increases in the amount of fodder available for livestock. in Ethiopia, which are high in quantity and quality for sustainable animal production (Tessema et al., 2002a; Tessema and Baars, 2004). They are promising due to their high productivity, palatability, high quality nutritive value and high-quality feeding value (Tolera et al., 2007) value and high-quality feeding value (Tolera et al., 2007)

## OBJECTIVE

* To evaluate biomass yield and biomass related component of different improved forage species under rain feed condition.
* To assess and evaluate the pastoralist perception towards the technologies transfer
* To assess the pastoralist criteria for selecting forage species

# Expected Output:

* Increased Livestock Productivity: Improved forage grasses provide higher nutritional value, leading to enhanced animal health, increased milk production, weight gain in livestock, and better reproductive performance.
* Sustainable Agriculture: These grasses can help improve soil health by reducing erosion, increasing soil organic matter, and improving nutrient cycling.
* Diversification and Resilience: Diversifying with improved forages can help farmers hedge against uncertainties like drought or climate change, providing a more resilient agricultural system.
* Increased Livestock Productivity: Improved forage grasses tend to have higher nutritional content, enabling livestock to grow faster, produce more milk, and maintain good health.
* Diversification of Income Streams: Forage grasses allow farmers to engage in livestock rearing alongside traditional crop farming, providing additional income sources.

# MATERIAL AND METHODS

## Description of the Study Area

This project is going to implemented in Shabeley district and is one of the district in the Somali region of Ethiopia part of Fafan zone, Shabeley is bordered on the west by Gursum, on the north by Tuli and east Jigjiga city council, south by Goljano Fafan zone based on the 2007 census conducted by central statistical agency of Ethiopia (CSA, this woreda has a total population of 82,286 of whom 45,094 are men and 37,192 women

The area is located 26 kilometres from Jigjig and 600 kilometres from Addis Ababa, the capital of the country the District is one of the districts where, and it has the capacity to a variety of forages and crops.

## Agricultural

sample enumeration performed by the CSA in 2001 interviewed 37,413 farmers in this woreda, who held an average of 1.05 hectares of land. Of the 39.37 square kilometers of private land surveyed, 81.21% was under cultivation, 10.6% pasture, 3.72% fallow, and 1.8% was devoted to other uses; the percentage in woodland is missing. For the land under cultivation in Shabeley, 66.08% is planted in cereals like teff, sorghum and maize, 1.61% in pulses, 1.61% in root crops, and 0.07% in vegetables. Permanent crops included 4108 hectares planted in khat, 1 in enset, and 14.55 in fruit trees. 78.33% of the farmers both raise crops and livestock, while 19.88% only grow crops and 1.79% only raise livestock. Land tenure in this woreda is distributed amongst 94.28% owned their land, 1.29% rented, and the remaining 4.43% held their land under other forms of tenure (Central Statistical Authority of Ethiopia. Agricultural Sample Survey (AgSE2001). Report on Area and Production - Somali Region. Version 1.1 - December 2007

#  Establishment of PAPREGs

 Once the sites were identified, a detail consultation meeting was organized with the communities. The 25 PAPREGS were selected purposively based on their interests to be included in the study activities; engaged mainly on livestock production and having potential role to share findings to other pastoralists. The target group may include experienced livestock keepers and pastoral community leaders. Hence, 25 farmers were included in this study all PAPREGs members participated. The site for the trial was also selected based on interest of farmers, representatives and consensus of the all PAPREGs members.

##  Participatory and Evaluation of Improved Forage

Four improved forage species namely Sudan Grass, Panicum Grass, Rhodes grass Used for the farm trial. The trial conducted on twenty-five selected PAPREGs members land. However before the beginning of the trial short term training for entire PAPREGs members were provided on the project intention. Following the successful accomplishment of activities rose below of improved forage species, land preparation, clearing. Plophing, sawing weeding, harvesting, and storing.

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# Experimental Design and Data collection

## Site selection

Location: Choose a site with suitable soil conditions and climate for forage growth. Consider accessibility for researchers and participants and Size: Determine the size of the experimental plots based on the experimental design and available resources, sites were identified by consultation meeting with the communities. The 25 PAPREGS were selected land about one-hectare Land allocated to cultivate were one Hector (1ha) This activity were carrying out Sinuiju- Kebele located in Shabeeley Districts selecting through discussion with Farmer’s members and based on their willingness and interest and select the land and farmers have involved in all stage of experiment with three improved forage were used for this experiment and evaluated for their general production performance production During site selection, there were big challenges on choosing site, due to the following reasons: pastoralist and agro-pastoralist communities farms have been covered with their own crops as cropping season started a head of this project implantation while on the other hand, weeds already covered none cropped lands; overflow and animal case were also a fear. After Shabeeley district Agricultural extension workers, research initiator team have successfully selected the site

# Treatments

Three forage varieties that were recommended by Somali pastoral and agro pastoral research institute which namely Sudan grass, Panicum grass and Rhodes grass were used as experimental units

The experiment was laid out in a randomized, complete block design with three replications. Each variety was planted on a plot size of 10 × 10 m, and the spacing between plants, rows, plots, and replications was 0.4 m, 0.50 m, 1 m, and 1.5 m, respectively. All agronomic management and cultural practices have been applied as per the requirements and recommendation. Accordingly, a seeding rate of 6kg/ha for Panicum, 12 kg/ha for Rhodes grass, and 12kg/ha for Sudan. A participatory variety evaluation was conducted at maturity, attended by PAPREG members, agro-pastorals from the area, researchers, and other stakeholders. Varieties were evaluated based on farmers' selection criteria. The trial fields were assessed at planting, maturity, and harvesting to track progress and identify any gaps

## Materials used

Quality seed were selected: Source high-quality seeds of the selected forage species, choose appropriate fertilizers as per soil nutrient and necessary tools for planting, data collection, and maintenance were prepared.

DAP and urea fertilizer were applied at planting and after establishment, respectively at the rate of 100 and 50 kg per ha for establishment and 25kg of urea were applied after each harvesting cycle for maintenance ((Danano, 2007) Weeding and related management practices were applied according to the grass’s requirements.

## Training

Research Team: Train researchers on experimental protocols, data collection methods, and safety procedures and Participants Conduct workshops to train farmers and stakeholders on forage cultivation, management practices, and the importance of the study.

# Field Visits

 Monitoring the Scheduled periodic visits to the experimental site to assess plant growth, health, and any issues that may arise. Data Collection: Train researchers to collect data on forage yield, quality, pest/disease incidence, and environmental conditions

# Field days

The Purpose of Organize field days to showcase the experimental setup, share preliminary results, and interact with stakeholders, conduct live demonstrations on forage management practices, data interpretation, and best farming techniques and Collect feedback from participants to improve future experimental designs and extension activities

site was monitored once a monthly by researchers and the data were collected to PAPRGs as well as development agent. Multidisciplinary approaches were implementing, monitor and observed how they collect all the necessary parameters. Like: Data to be collected, Planting date Germination date (50%), Flowering date (50%), Se, Harvesting date, Biomass yield and Resistance to pest and disease.

# Roles of pastoralists/agro-pastoralists, extension workers and researchers

All farmer groups, extension workers, experts and researchers were involved at plantation and regular field evaluation, and each group were the following responsibility: -

1. **Farmers: -**were expected to provide land for trial, managed trials, weeding, and discuss progress among PAPREGs member farmers, keep recorded and encouraged visit by others.
2. **Extension workers:** - was expected to mobilize resource, facilitate activities among farmers, linking other farmers and PAPREGs member farmers and keep activity recorded encourage other farmers to visit the plot, arranged farmers meeting, flow up the trial.
3. **Researchers:** - were expected to listen what are the farmers comment, provided appropriate technical information, help farmers analyzing situations and trial and process the data to verify the result an d providing training to the PAPREGs member farmers.

##  Data Analysis

The data on yield and yield component which has collected from the forages were summarized and analyzed using analysis of variances (ANOVA) in SAS statistical software. Treatment effects were assessed by Analysis of Variance (ANOVA) using SAS ver.26 computer packages (Gomez and Gomez, 1984). Treatment means was separated using Least Significant Difference (LSD)

# RESULT AND DISCUSSION

## Training of the PAPPRAG

Objective of the training were: To understand the Forage production technologies there by to enhance the production and productivity of forage in Shabeley district particularly Sinujif Kebele awareness creations on forage production. Research Team: Train researchers on experimental protocols, data collection methods, and safety procedures and Participants Conduct workshops to train farmers and stakeholders on forage cultivation, management practices, and the importance of the study

Researchers from SoRLARI, those who were responsible for the project gave meaningful training to the PAPPRGS (Farmers, DAs and SMS) so as to capture important understanding on Forage production technology. Hence twenty-five farmers, DAs and two subject matter specialists were trained by the researchers on the following core points like Land preparation and layout, weed management harvesting and storing

Finally the participants witnessed that they understood and captures important points from the training that can serve as sustainable input for their improved forage production technology activities.

 **Table 1. training**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S/n** | **Sex** | **Farmers**  | **Percent%** | **DAs** | **Percent%** |
| 1 | Male (adult) | 17 | 68% | 1 | 100 |
| 2 | Female (adult) | 8 | 32% |  |  |
| 3 | Sub total  | 25 | 100 | 1 | 100 |
| 4 | Total |  |  |

 ***DAs: Developmental agents***

## Yield performance and yield related traits

The study shows of Panicum, Rhodes and Sudan grass varieties are presented in table 2. The result reveal that the maturity, height and dry matter yield (qt/ha) were significantly different (P<0.05) among these varieties. The highest plant height was recorded from Sudan grass (2.06m) followed by Panicum grass (1.75cm) and Rhodes (70cm) grass respectively, as well as

Biomass yield of Sudan and Panicum grass was significantly (p<0.05) higher than Rhodes grass and (12 t/h, 9t/ha, 8.7t/h respectively, (Kumar et al., 2012) .Moreover, Sudan grass and Panicum grass produced significantly (P<0.05) higher plant higher plant height then Rhodes grass the Sudan grass had significantly (p<0.0) higher dry matter yield than Panicum, Rhodes grass,

Moreover, Sudan grass and Panicum grass produced significantly (P<0.05) higher plant height then Rhodes grass. Furthermore, the Sudan grass had significantly (p<0.05) higher dry matter yield than Panicum, Rhodes grass Dereje et al., (2024) on the other hand, Sudan grass had significantly (P<0.05), early maturity than Sudan, Rhodes grass variety.

In this study Rhodes grass has a higher ability to adapt to the tested agro-ecology than the other varieties, which accounts for its lower dry matter production, higher dry matter yield According to farmers, biomass of Sudan grass and Panicum grass high and recommended area were feed shortage . The result obtained from this study is similar to researches done so far by SoRPPARI in different agro ecology that reported slightly similar to this finding.

Table 2: dry Matter yield, plant height m and maturity days, at Shabeley District (cropping season)

|  |  |  |  |
| --- | --- | --- | --- |
| Tested species | Plant height (m) | Maturity days | Dry Mater Yield (qt/ha) |
| Panicum Grass | 1.75a | 82b   | 9b  |
| Rhodes Grass | 0.70b | 91b  | 6.7a |
| Sudan Grass | 2.06 a |  67a | 12b |
| P-Value  |  <.001 | 0.005 | 0.002 |
| LSD 0.05)  | ⁎⁎⁎ | ⁎⁎⁎  |  ⁎⁎⁎ |

 ⁎⁎⁎ highly significant level, Dry matter yield quantal per hectare.

*Figure 1: The dry matter yield, plant height and maturity of Panicum, Panicum grass and Rhodes Grass.*

# Pastoralists/agro-pastoralists perception

All pastoralist member of the research group was participated in selecting better forage species. Hence, According to the results from this pairwise comparison closely correspond with existing research on forage preferences among agro-pastoralists

In addition, biomass yield was ranked first, emphasizing the importance of high-yield forage varieties that increase feed availability. Studies in Ethiopia have demonstrated that species like Napier grass (Pennisetum purpureum) and Desho grass (Pennisetum pedicellatum) are favored due to their substantial biomass production and adaptability to local climatic conditions (Aleme et al., 2024).

Palatability was the second key factor, suggesting that livestock acceptance significantly influences forage selection Forages that animals readily consume lead to higher intake, better digestion, and enhanced overall productivity. Evidence shows that leguminous forages such as alfalfa (Medicago sativa) and lablab (Lablab purpureus) are particularly preferred because of their high protein content and superior taste (Simone et al., 2023). Drought tolerance, ranked fourth, remains an essential consideration, especially in dryland areas where extended dry periods can severely impact forage availability. Research highlights that deep-rooted species like Brachiaria and Buffel grass (Cenchrus ciliaris) are highly valued for their ability to withstand moisture stress and sustain production under challenging conditions (Abu-Alrub et al., 2014).

Pair-Wise Ranking Matrix for Selection Criteria

Pair-wise ranking of the pastoralists’ selection criteria was made to rank the selection criteria and to identify the most important trait for the PAPPRAGs for future forage improvement. The pastoralists and agro- pastoral were deliberate to compare the criteria and rank them in order of importance. In the pair-wise comparison similar result was shown in experimental sites (Table 3). Community perception towards the experimental grasses and Species preference for individual selection criteria: All PAPPRAGs members of were participated in selecting better forage species. Hence, according to the amount of forage product they produce in areas

Accordingly, the selection criteria were compared biomass ranked first forage product they produce in the areas, palatability, Early maturity, drought tolerant, easy to established height at harvesting and easy to manage supported by Mganga et al. (2015) and Aberra et al. [2010]. Regeneration capacity, Biomass and Early maturity ranked respectively. Participatory evaluation of forage grasses is important to understand

Overall, the findings indicate that agro-pastoralists favor forage varieties that are high-yielding, palatable, quick-maturing, and, with moderate regard for drought tolerance and sustainable harvesting practices. These insights are valuable for breeding programs, policymakers, and extension services, as they clarify which traits should be prioritized in developing improved forage options. Future breeding initiatives should aim to select and promote forages that maximize productivity while remaining resilient to climate variability.

Table3. Pair-Wise Ranking Matrix

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Species  | BY | P | EM | SP | DT | DPR | EMA | RC | points | Rank |
| Biomass yield |   | BY | BY | BY | BY | BY | BY | BY | 8\* | 1 |
| Palatability |   |   | P | P | P | P | P | P | 7\* | 2 |
| Early maturity |   |   |   | EM | EM | EM | EM | EM | 6\* | 3 |
| Seed production |   |   |   |   | DT | SP | EMA | RC | 2\* | 7 |
| Drought tolerance |   |   |   |   |   | DPR | DT | DT | 5\* | 4 |
| Regeneration capacity resistance |   |   |   |   |   |   | EMA | RC | 4\* | 5 |
| Easy of management |   |   |   |   |   |   |   | RC | 1 | 8 |
| Disease and pest resistance. |   |   |   |   |   |   |   |   | 3\* | 6 |

# Conclusion and Recommendation

the current study different improved grass species evaluated for their biomass yield production potential under rain fed lowland area. Among the improved grass forage species tested, Sudan grass and Panicum, and produced higher biomass yield which result the study. The grasses are listed in This design allows for a demonstration Land preparation was done before planting of the forage crop. The seed of Sudan Grass, Panicum Grass, and Rhodes’s grass sowed by farmers the study were conducted using randomized complete block design (RCBD) with three replications,

The biomass yield obtained in this study revealed that there was significance difference (p < 0.05) among the tested improved forage Grass species in the study area. The biomass yield production potential of tested species under rain fed condition in to the study area were (12 t/h, 9t/ha, 6.7t/h Sudan Panicum grass and Rhodes Grass respectively. Sudan and Panicum grass grass showed higher vegetation and perception performance; therefore, these grasses should be tested in different areas and disseminated to the community by creating awareness about proper management system.Overall, the findings indicate that agro-pastoralists favour forage varieties that are high-yielding, palatable, quick-maturing, and, with moderate regard for drought tolerance and sustainable harvesting practices. These insights are valuable for breeding programs, policymakers, and extension services, as they clarify which traits should be prioritized in developing improved forage options. Future breeding initiatives should aim to select and promote forages that maximize productivity while remaining resilient to climate variability

The approach provided the means for feedback on technologies generated and disseminated It's found that the PAPPRG are effective and efficient approaches in generating, evaluating and disseminating forage technologies. SoRPPARI research centre used this approaches as means to address the week technology adoption of the various forage technologies so far developed. The valuable contribution of these approaches towards the realization of the goals of the centre is well acknowledged and appreciated

Therefore, it is very important to evaluate the forage species for more seasons under similar agro ecology and addition to their farmer’s response based on biomass yield it is recommended Sudan and Panicum are recommended based on information obtained from this study would benefit the pastoral communities, so the promotion of the tasted species will be demonstrated and scaled out in wider range through pre-scale-up

Therefore, it is recommended to test other forage species not evaluated under the current study. Intensive community training how to produce improved forage species particularly during long rainy season could probably result in better performance and policy make can also prepare complete package on how to establish and adapt improved forages species in dry land ecosystem

These recommended to scale up such improved forage species among the stock holders and more effort need in next implementation programs in terms of funding for training more number of farmers, and involvement of other stock holders like higher institutes and other governmental and non-governmental bodies need to supplying planting materials and seed and also policy makers give priority for this sector to reach the technologies throughout small scale farmers in the country

# Lesson learned

* Education and Awareness: Educating farmers about the benefits of improved forage grasses is crucial for adoption. Extension services play a vital role in disseminating knowledge.
* Adaptation and Selection: Different forage grasses are suited to different regions and farming systems. Selection of the appropriate species is key.
* Monitoring and Evaluation: Regular monitoring of forage grass performance can help farmers make informed decisions regarding management practices.
* Education and Training: Successful implementation requires proper education and training programs to ensure farmers understand the value of improved forage grasses.
* Local Adaptation: Adapting forage solutions to local conditions and practices can enhance adoption rates and effectiveness.
* Capacity Building: Providing training and extension services to farmers on modern forage production techniques, sustainable land management practices, and pest/disease control can enhance productivity.

# Future Focus

* Climate-Smart Agriculture: Promoting climate-smart forage production techniques that are resilient to climate change and optimize resource use.
* Sustainable Land Management: Implementing practices such as agroforestry, rotational grazing, and soil conservation to prevent land degradation and improve soil health
* Market Diversification: Exploring new markets for forage products and developing value chains to increase the economic value of forage crops.
* Agriculture: Embracing technologies for farm management, market information, and extension services

# Challenges

* Technical Knowledge: Some farmers may lack the technical expertise required to effectively manage and utilize improved forage grasses.
* Market Access: Ensuring a market for the surplus forage or the livestock products is essential to make the adoption economically viable.
* Access to Quality Seeds: Limited availability of quality forage seeds can hinder widespread adoption.
* Resource Constraints: Many small-scale farmers may lack resources to invest in establishing and maintaining improved forage grasses.
* Climate Variability: Ethiopia's diverse agro-climatic conditions make forage production susceptible to climate change impacts such as erratic rainfall patterns, prolonged droughts, and increasing temperatures.
* Limited Resources: Small-scale farmers often lack access to quality inputs like improved seeds, fertilizers, and limiting forage productivity.
* Land Degradation: Overgrazing and improper land management practices have led to land degradation, reducing the productivity of forage crops.
* Pests and Diseases: Forage crops are vulnerable to various pests and diseases that can significantly reduce yields if not managed effectively.
* Lack of Knowledge and Extension Services: Limited knowledge about modern forage production techniques and inadequate extension services hinder the adoption of improved practices.

# Opportunities

* Research and Development: Continued research into new varieties of forage grasses can lead to further improvements in yield, quality, and resilience to environmental stress.
* Policy Support: Government policies that promote the adoption of improved forage grasses can incentivize farmers to include them in their cropping systems and Collaboration between government agencies, research institutions, and private sector actors can improve seed availability and distribution
* Market Development: Growing demand for high-quality livestock products creates opportunities for farmers to capitalize on the benefits of improved forage grasses. Improved forage grasses indeed provide significant benefits to both livestock and crop farmers in Ethiopia.
* Capacity Building: Providing training and extension services to farmers on modern forage production techniques, sustainable land management practices, and pest/disease control can enhance productivity
* In Ethiopia, improving forage grasses can play a pivotal role in enhancing agricultural sustainability, livestock productivity, and resilience to climate change. Efforts to address challenges and leverage opportunities can lead to significant positive impacts on farmers' livelihoods and the agricultural sector as a whole

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