Fodder resources, availability, practice challenges in the Indian dairy sector

Training cum Workshop
on
Prevention and Sustainability in the Indian Dairy Sector for Productivity, Livelihood and Climate
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Anil Agarwal Environment Training Institute, Nimli, Rajasthan

Dr.Devendra Ram Malaviya
E-mail: malaviya2007@yahoo.co.in

Synopsis

Livestock scenario - India

Feed and fodder requirement

Forage Resource

Forage production from arable land

Grassland/ Rangelands resource

Hortipastoral and silvipastoral systems

Forage conservation

Livestock production – impacting environment

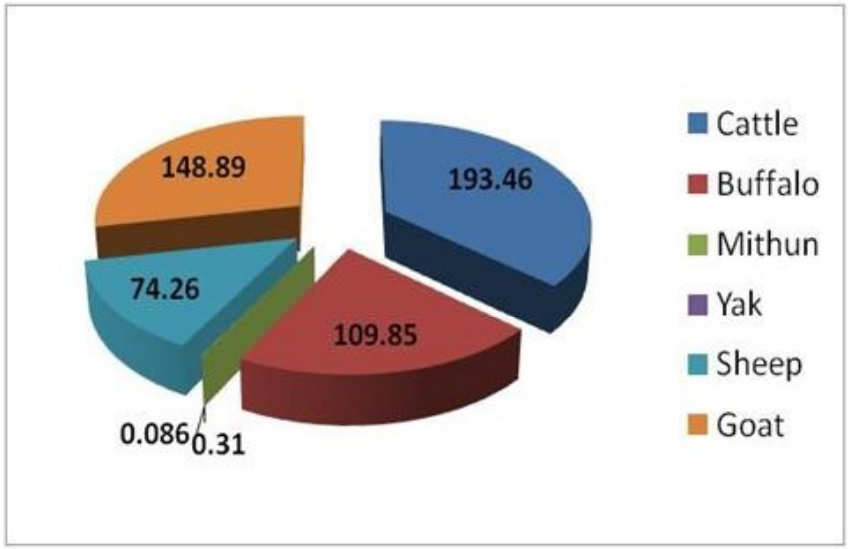
Feeding impact on milk production

Livestock scenario - India

- Livestock production key to sustainability backbone of Indian agric.
- Contributes 4.11% to national GDP; 25.6% of agri GDP
- Employment and livelihood -70% rural population.
- India - 20% of the world's livestock on only 2% of World's geographical area

* A challenge to feed the fast increasing livestock population

Livestock population (in million)



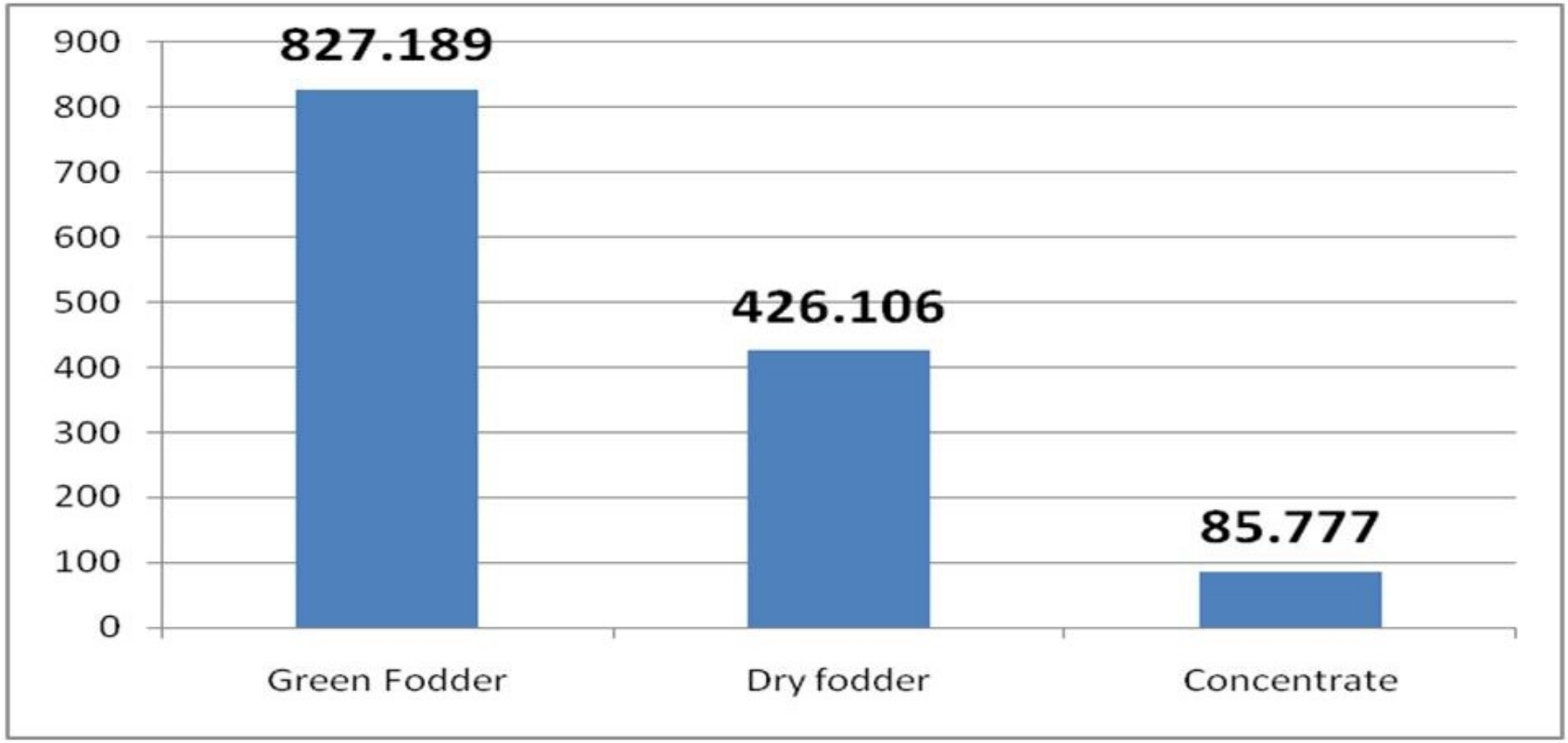
Total : 526.85 m ; Converted to ~245.3 ACUs

% Change 4.8% in 2019 over 2012; CAGR: 7.67%

milk production: 230.58 m t ;

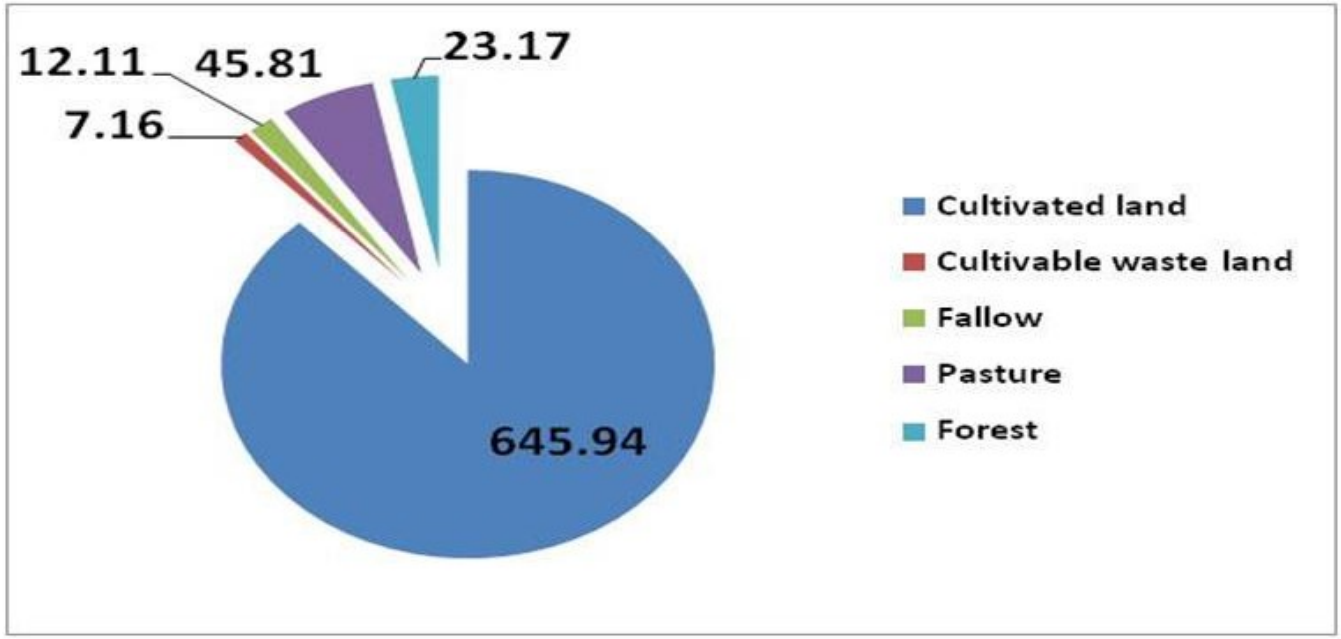
Annual productivity of cattle: India: 1777 kg per animal per year ; world : 2699

Feed and fodder requirement estimate (m t)



Green fodder availability

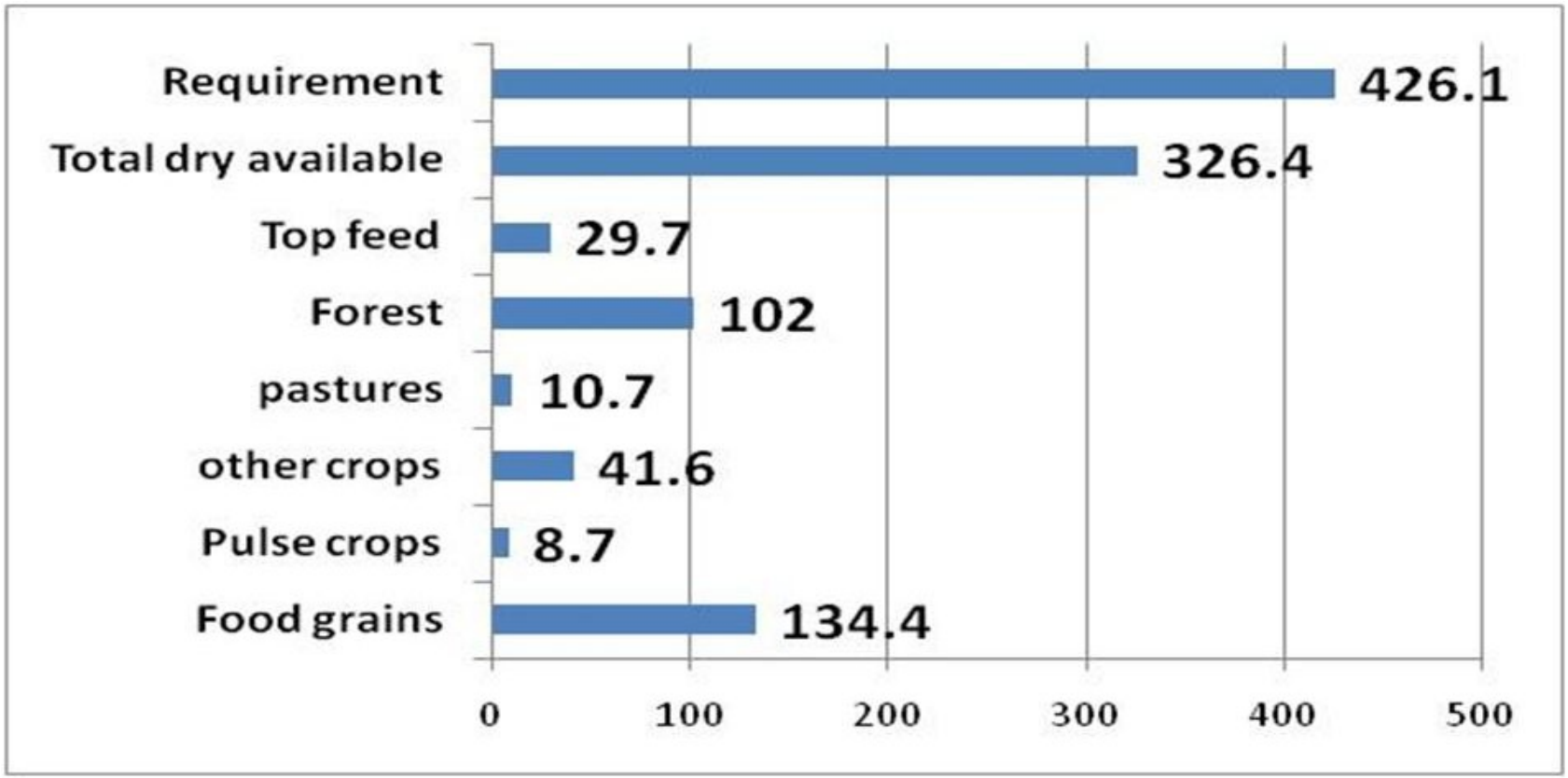
(from different sources)



Total requirement: 827.19 mt

Availability: 88.7% Deficit: 11.24 %

Dry fodder availability (mt)



Forage Resource

- Cultivated forage from arable land
- Rangelands/ grasslands/ forest areas

FORAGE PRODUCTION FROM ARABLE LAND

Popular cultivated forages

SORGHUM (Chari)



- Season: Kharif
- Seed Rate: 15-20 kg/ha
- Row Spacing: 30 cm
- NPK: 90:30:0 kg/ha
- Isolation: 200m (FS) 100m (CS)
- Seed yield: 6-17 q/ha
- Fodder yield: 55-70t/ha
- Germination %: 75
- Purity % : 97

Maize (Makka)



- Season: Kharif
- Seed Rate: 25-30 kg/ha
- Row Spacing: 50 cm
- NPK: 90:30:30 kg/ha
- Isolation: 400m (FS)
  200m (CS)
- Seed yield: 18-22 q/ha
- Fodder yield: 30-55t/ha
- Germination %: 90
- Purity % : 98

COWPEA (Lobia)



- Season: Kharif
- Seed Rate: 20-30 kg/ha
- Row Spacing: 50 cm
- NPK: 60:40:30 kg/ha
- Isolation: 10m (FS)
  5m (CS)
- Seed yield: 7-10 q/ha
- Fodder yield: 25-30t/ha
- Germination %: 75
- Purity % : 98

Cyamopsis tetragonoloba (Guar)



- Season: Kharif
- Seed Rate: 20-30 kg/ha
- Row Spacing: 40 cm
- NPK: 60:40:30 kg/ha
- Isolation: 10m (FS)
  5m (CS)
- Seed yield: 5-9 q/ha
- Fodder yield: 15-30t/ha
- Germination %: 70
- Purity % : 98



OAT (Jai)



- Season: Rabi
- Seed Rate: 50-60 kg/ha
- Row Spacing: 25 cm
- NPK: 90:30:0 kg/ha
- Isolation: 3m (FS)
  3m (CS)
- Seed yield: 12-22 q/ha
- Fodder yield: 40-50t/ha
- Germination %: 85
- Purity % : 98

Oat, JHO-822 fodder crop ready for second cut



Trifolium alexandrianum (Berseem)



- Season: Rabi
- Seed Rate: 20 kg/ha
- Row Spacing: 35 cm
- NPK: 20:80:30 kg/ha
- Isolation: 400m (FS)
  100m (CS)
- Seed yield: 4-7 q/ha
- Fodder yield: 60-100t/ha
- Germination %: 80
- Purity % : 98

Berseem BB-3 seed production , Ricchore, Jhansi
















Lucerne

Lucerne



Pearl millet



High biomass cultivated perennial grasses

Panicum maximum (Guinea grass)



- Season: Kharif
- Seed Rate: 3-5 kg/ha
- Row Spacing: 50 cm
- NPK: 80:50:50 kg/ha
- Isolation: 20m (FS)
  10m (CS)
- Seed yield: 0.3-0.5q/ha
- Fodder yield: 70-140t/ha
- Germination %: 20
- Purity % : 80

NxB Hybrid



Production technologies

Berseem + Mustard - Hybrid Napier + Cowpea

Berseem + Mustard – Maize + Cowpea - M.P. Chari + Cowpea

Berseem + Mustard- M.P. Chari + Cowpea

Round year production system

Guinea grass + Cowpea - Berseem

Berseem - Hybrid Napier - Cowpea

Hybrid Napier + Leucaena

Berseem - Maize + Cowpea - Fodder Sorghum + Cowpea

Oat- Fodder Sorghum-Turnip

Berseem – Cowpea - Fodder Sorghum + Cowpea

Deenanath grass - Berseem

Problem soils for forage production

Salt stress

Dicanthium annulatum, **Guar, *Dhaman* grass, Setaria, *Dhavalu* grass, Blue Panic, Rhodes, Para, *Cyanodon,* Guinea , Kallar grass (*Leptochloa fusca*)**

Waterlogged areas

Echinochloa polystanchy **and Para grass, *B. decumbense*, Karnal grass, Khas, congosignal grass.**

Grassland/ Rangelands resource

- **World grazing land - 32 m km^2 , occupies 26% of earth's surface**
- **Support 20% world's livestock population**
- **Pastoralism -most widespread land-use system**
- **Mutifucntional: livestock grazing, medicinal plants, habitat for wildlife, hydrological balance, checking soil erosion, supporting pollinators**
- **Conserves 20% of the world's soil carbon stocks.**
- **India - 100 m ha underutilized.**
- **12.15 m ha permanent pastures**
- **Rangelands reduced -70 m ha to 38 m ha in last 50 yrs**
- **Large area converted to plantations/ Protected Areas/industrial establishment**

Grassland Productivity

- **Semi-arid grasslands - carrying capacity 1 ACU/ ha with stocking rates 51 ACU / ha**
- **Arid grasslands - carrying capacity 0.2-0.5 ACU / ha with stocking rates 1 to 4 ACU / ha.**
- **India with huge area under rangelands can be a hub of organic livestock production such as milk, meat**

PRODUCTION POTENTIAL OF DIFFERENT GRASS COVER IN INDIA

Grass Cover	Area 000 km^2	Biomass yield (t/ha)
Sehima-Dicanthium	1740	6.0
Dicanthium-cenchrus-Lasiurus	436	5.0
Phragmitis-Saccharum-Imperata (temperate alpine cover)	2800	5.0
Thameda-Arundinella	230	4.0

•Potential - 75% area under *Sehima- Dichanthium* cover is improved - 0.65 t /ha to 1.75 t /ha, availability increase from 83 Mt to 224 Mt.

Notable grasslands with ethnic value

- **Terai-Duar Savanna and Grasslands (Eco-region at the base of the Himalayas)**
- **Banni Grasslands (maintained by Kutch pastoralists)**
- **Kangayam grassland (Sustainably managed for >150 yrs, *Cenchrus* dominated)**
- **Shola grassland of the Western Ghats**

***Have lived long -scientific approach for rejuvenation**

Terai-Duar savanna and grasslands



Banni Grasslands

Kutch pastoralists.
around 2400 sq km area.



Kangayam grassland



Bagwal, HP



Range Grasses and legumes

Cenchrus ciliaris (Anjan)



- Season: Kharif
- Seed Rate: 3-5 kg/ha
- Row Spacing: 50 cm
- NPK: 60:30:30 kg/ha
- Isolation: 20m (FS)
  10m (CS)
- Seed yield: 0.6-1.5q/ha
- Fodder yield: 15-40t/ha
- Germination %: 30
- Purity % : 80

Cenchrus setigerus (Dhaman)



- Season: Kharif
- Seed Rate: 3-5 kg/ha
- Row Spacing: 50 cm
- NPK: 60:30:30 kg/ha
- Isolation: 20m (FS)
  10m (CS)
- Seed yield: 0.5-0.9q/ha
- Fodder yield: 10-30t/ha
- Germination %: 30
- Purity % : 80

Brachiaria brizantha (Signal)



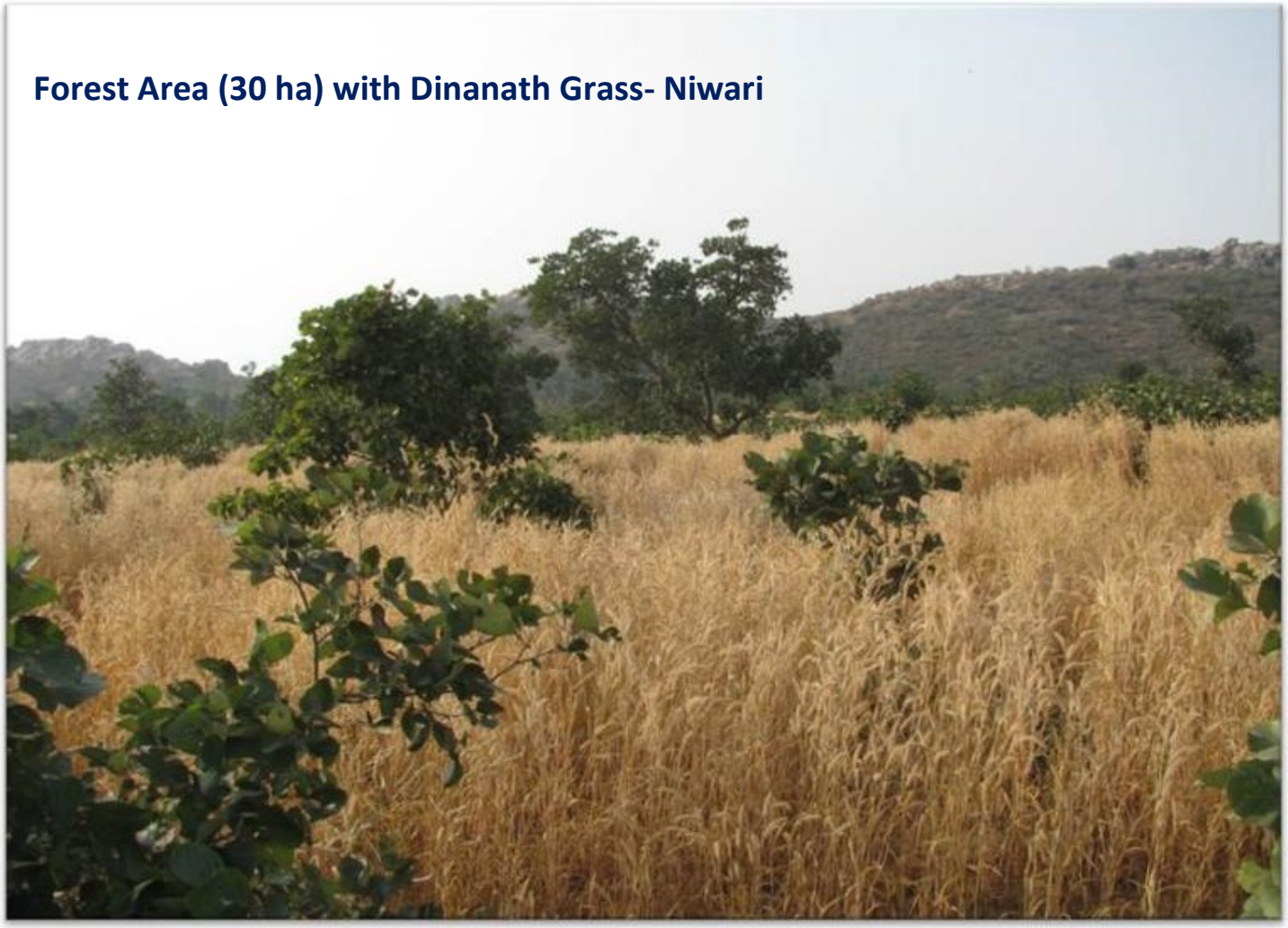
- Season: Kharif
- Seed Rate: 6-10 kg/ha
- Row Spacing: 50 cm
- NPK: 60:40:30 kg/ha
- Isolation: -
- Seed yield: 0.25-0.6q/ha
- Fodder yield: 50-80t/ha
- Germination %: -
- Purity % : -

Peenisetum pedicellatum (Dinanath)



- Season: Kharif
- Seed Rate: 5-8 kg/ha
- Row Spacing: 50 cm
- NPK: 60:40:30 kg/ha
- Isolation: 20m (FS) 10m (CS)
- Seed yield: 3-5 q/ha
- Fodder yield: 50-90t/ha
- Germination %: 50
- Purity % : 95

Forest Area (30 ha) with Dinanath Grass- Niwari



Clitoria ternatea (Butterfly pea)



- Season: Kharif
- Seed Rate: 15 kg/ha
- Row Spacing: 40 cm
- NPK: 30:40:40 kg/ha
- Isolation: -
- Seed yield: 0.6-1.0q/ha
- Fodder yield: 20-30t/ha
- Germination %: -
- Purity % : -

Macroptilium atropurpureum (Siratro)



- Season: Kharif
- Seed Rate: 10-15 kg/ha
- Row Spacing: 40 cm
- NPK: 60:40:30 kg/ha
- Isolation: -
- Seed yield: 1.5-2.5q/ha
- Fodder yield: 15-25t/ha
- Germination %: -
- Purity % : -

Stylosanthes hamata (Stylo)



- Season: Kharif
- Seed Rate: 8-10 kg/ha
- Row Spacing: 40 cm
- NPK: 30:40:40 kg/ha
- Isolation: 50m (FS)
  25m (CS)
- Seed yield: 8-12 q/ha
- Fodder yield: 30-55t/ha
- Germination %: 40
- Purity % : 90

Sewan grass





Waste dump stabilization with Geo-textile

Dudhawa

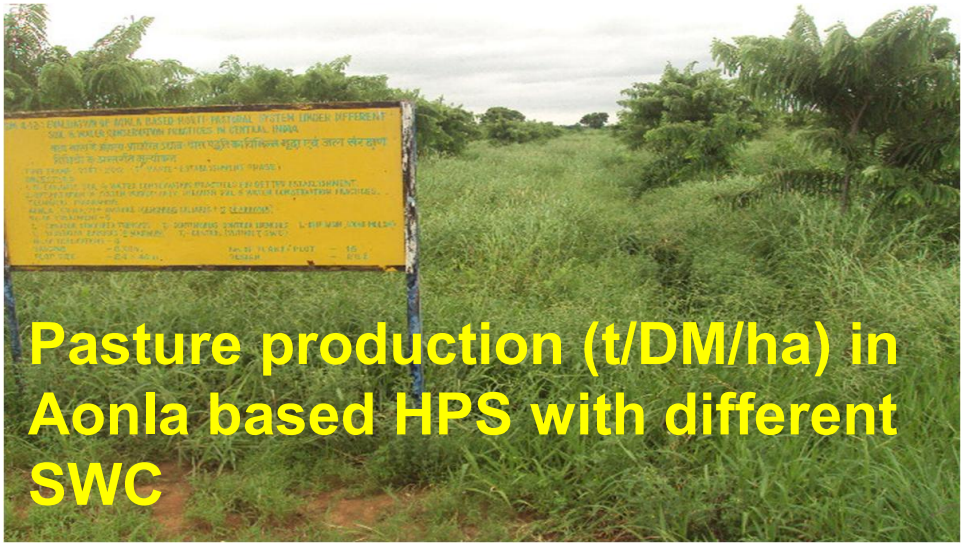




Strategy for grassland development

- **Developing atlas of rangelands / grasslands**
- **Making rangeland/grassland an economically viable option of livelihood**
- **Community participation**
- **Gaushalas/ Gram Aranya/ Model grasslands to reduce pressure on grazing land**
- **Discouraging allotment of grazing lands for other purposes.**
- **Safeguarding pastoralist interest**

Hortipastoral and silvipastoral systems
&
Fodder tree/shrubs



Pasture production (t/DM/ha) in Aonla based HPS with different SWC



Aonla based cropping system

20 yrs old *A.tortilis* + *C. ciliaris* silvopastoral system





Fodder shrub: *Ziziphus nummularia*



Khejari(***Prosopis cineraria***): Important fodder tree of western Rajasthan



Improved thorne less Khejri plant

Hedge lucerne



Guinea in horto-pastoral system



Ber based horto-pastoral system

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Forage conservation

Conservation technology



- Baling technology
- Leaf meal technology
- Feed pellet technology
- Complete Feed Block technology
- Urea treatment technology
- Hay making
- Silage technology





Conservation technology (contd.)

- Wheat straw (threshed) needs binding agents to densify



- Unthreshed wheat straw can be baled without any binding agent



Conservation technology (contd.)

- **Complete feed block :**

  Wheat straw - 40%
  Berseem hay - 20%
  Molasses - 20%
  Conc. Mixture- 19%
  Mineral & vitamin - 1% CP - 9.7%



Conservation technology (contd.)

- **Baling of crop residues** enhances transportability and storability
- Bales of 10-30 kg weight and 110-150 kg/m3 density could be made
- Baling saves 3-4 times storage space
- Transportation cost saved by 2-3 times







Livestock production – impacting environment

- **Livestock production - 14.5% of global greenhouse gas emissions**
- **Enteric methane (CH4) emission contributes up to 40% of livestock's GHG**
- **In totality consider CH4 emissions vs-a-vis soil C sequestration potential of fields having served for feed**
- **Increased forage digestibility resulting in increased dry-matter intake and consequently increased CH4 emission not true for sheep**

- **methane production for the cut and-carry and grazing groups is 17% and 39% lower than for the total mixed ration.**

- **Europian grasslands - 52 g C/m2/year carbon from established grassland and 144 g C/m2/year from converted - net sources for GHGs - sequestering C in soils outweighed by the emissions of N2O from soils and CH4 from livestock. (Not in Arid/semiarid grasslands)**

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Carbon Sequestration

- **World soils sequestration 0.4 to 1.2 Gt per year carbon (0.01-0.30 Gt grasslands)**

- **The top meter of grassland soils store around 49 tonnes of carbon dioxide equivalents per acre.**

- **In global context, grasslands store 34%, forests 39% and agro-ecosystems 17% of the global terrestrial stock of carbon**

- **Grasslands - SOM, averaging 333 Mg/ha**

Methane mitigating – Feeding options

- **Feeding ruminants on high-quality forages decreases GHG**
- **Legumes decrease GHG dietary measures**
- **Pasture legumes reduce the need for mineral N fertilisation.**
- **Increasing forage digestibility and digestible forage intake - one of the main CH4 mitigation practices**

Management practices to increase carbon stocks

- **Improved grazing management leads to an increase of soil carbon stocks by an average of 0.35 Mg C /ha/yr.**
- **Species such as *micropitilum lathyroildes / Stylosanthes guianensis / Leucaena leucocephala* improves SOC**
- **Adopting Silvipasture system enhances carbon uptake by lengthening the growing season**
- **Thus, conversion of 630 million ha of unproductive or degraded croplands and grasslands to agroforestry can sequester 0.59 Tg C annually by 2040**

agroforestry – mean 95 Mg/ha

Feeding impact on milk production

Contributing factor in animal productivity

Feeding and Nutrition Management (~50% – 60%)

Balanced rations : Enhance milk yields or growth rates by 20% to 25% compared to deficient diets

Breeding and Genetics (~30% – 40%)

Health, Housing, and General Management (~10% – 20%)

400 kg cow
buffalo





Thumb rule to estimate the Roughage and concentrate requirement

DM Intake: 2.5-3.0 % of body wt

DM requirement: 10-12 kg

Concentrate: 1/3 = 3.3-4 kg

2/3Roughages = 6.7- 8 kg

1/3 green= 2.23-2.7

2/3 dry:=4.47-5.3

Rationing (as such basis) high yielding milch cows

Feedstuffs/ Items	Quantity (kg/head/d)
A. Category-I(350 kg,15 kg daily milk yield & 4-5% fat	
Maize/sorghum/ oat	20
Berseem/ lucerne/ cowpea	25
Wheat/ rice straw	1
Concentrate mixture (20% CP, 72% TDN)	5
B. Category-II (350-400 kg, 25 kg daily milk yield & 4-5% milk fat	
Maize/sorghum/ oat	20-25
Berseem/ lucerne/ cowpea	20-25
Concentrate mixture (22% CP, 74% TDN)	8-9

Comparison of Core Dairy Feeding Systems

Feeding System	Description	Advantages
Total Mixed Ration (TMR)	forages, concentrates, minerals, and vitamins in a uniform mix.	• Eliminates selective eating • Stabilizes rumen pH • Minimizes digestive upsets
Component Feeding (Traditional)	Forages and concentrates fed separately at different times of the day.	• Low capital investment • Simple to implement manually
Partial Mixed Ration (PMR)	A baseline TMR is fed at the bunk, while high-producing cows receive extra concentrates during milking.	• Individualized nutrition based on yield • Excellent incentive for robotic milking
Intensive Management Pasture (Rotational Grazing)	Cows moved through subdivided paddocks systematically to consume high-quality, fresh forage.	• Very low feed harvesting costs • Promotes high animal welfare

Ideal milch animals ration –
three type of green fodder i.e. Grass/cereal fodder, leguminous and tree fodder.

Animals yielding 8-10 litres of milk can be maintained solely on green fodders without any complaint and reducing feed cost by 20% over normal dry roughages and concentrates based rations

NUTRACEUTICAL AND PHARMACEUTICAL PROPERTIES OF FODDERS

Bioactive compounds	Pharmaceutical values	Fodders
Flavanoids& flavones	Antimicrobial, antileishmanial, antifungal, antioxidant, anticancer,	Trifolium, pearl millet, sugarcane, Napier grass, chicory
Tricin	Antihistaminic, anticancer, antioxidant	pearl millet
polyphenols	anti- (inflammatory, carcinogenic, microbial, diarrheal, antioxidant, antiulcer)	Pearl millet, sugarcane, Napier grass
Policosanols	Antihepatotoxic, antihyperglycemic, analgesic, antithrombotic, anti-inflammatory	Sugarcane
Isoflavanoids, Saponins	Estrogenic, antifungal, anticancer, antimicrobial, anticancer, anti-inflammatory, anti-ageing, hepatoprotective	Trifolium
Carotenoids	Antioxidants, pigmentation	Maize
β-glucan	antidiabetic, anti-obesity, and immunomodulatory and hypercholesteremic	Oats, wheat, Barley
avenanthramides	Antioxidant and immunomodulatory	Oats

Message

To increase area in cultivated land for forage appears difficult

Alternative

Increase dependency on non arable lands – Grasslands

It is environmental friendly also.

Lot has been researched

Technologies developed

It's time to convince Govts to take up the grassland development programmes in a mission mode.

Let's green the grasslands and rangelands of the country

Get ready to Embrace the charm of the grassy plains
and
Save the environment

Thanks