



ORIGINAL RESEARCH PAPER

BOTANY

STUDY OF PHYTODIVERSITY OF A GRASSLAND COMMUNITY OF AMBADIHA WITH SPECIAL REFERENCE TO HUMAN WELFARE, ODISHA, INDIA

KEY WORDS: Phytodiversity, grassland community, human welfare, soil erosion.

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ABSTRACT

A Grassland community of Ambadiha (86033'E ; 210 35'N) in the district of Mayurbhanj, Odisha was studied to assess the phytodiversity of various species with special reference to their utility. Extensive field study was carried out from January 2016 to December 2016. The community comprised of 33 species grouped under 28 genera and 9 families. Out of 33 species, 18 species belongs to grass family (Poaceae) whereas the rest 15 species to the non-grass family i.e. one species each from the family Amaranthaceae, Asteraceae, Euphorbiaceae, Fabaceae and Scrophulariaceae; two species each from Commelinaceae and Rubiaceae and six species from the family Cyperaceae. 67% of species in the community showed medicinal properties. A few of them are used as fodder, famine food, vegetables, creating lawns, making, hats, mats, hand fans and other items. Most of the species help in controlling soil erosion and needs to conserve for human welfare.

Introduction

Grassland is a land in which the vegetation is mainly dominated by grasses, legumes and composites. According to Risser (1995), grassland is a typical biological community dominated by grasses and contains few trees or shrub. Grasses have a great importance on the living world. The human being along with animals and insects are directly or indirectly depends upon the grassland flora. They provide food to grasshopper and other herbivorous animals. Most of the World's population depends on the members of grass families i.e. rice (*Oryza sativa*), wheat (*Triticum aestivum*) and maize (*Zea mize*) as their food. Some of the grassland floras are used as unani medicine, decorative material in lawns and gardens, thatching purposes, rope making, rosary and ornaments. Grasses have a great value to prevent soil erosion because of fibrous root system that adheres tightly to the soil (Bhuyan & Barik, 2017). Recently, grassland researches have been given a prominent place in various government and nongovernment planning to conserve and manage grassland in both developed and developing countries.

Literature Review

The population growth followed by human demand and applied technology have chiefly affected the grasslands all over the world. Humans turn the grassland into their agricultural land for the cultivation of various crops. Punjab is one of those areas which are mostly cleared for the agricultural purpose. Not only the grasslands, but also some forests are being cleared up day by day for this reason. Literature reviewed reveals a lot of work on grassland community in India and Abroad. Odum (1960), Sant (1962 & 1965), Choudhury (1964), Singh (1967), Ambasht and Maurya (1970), Singh and Ambasht (1980), Redmann (1975), Misra and Misra (1984, 1986), Tripathy (1989), Barik and Misra (1998), Ejrnaes and Bruun (2000), Batalha and Martins (2004), Ghani and Khalik (2006), Patel and Patel (2010), Kar **et al.** (2010), Rahim **et al.** (2011), Pandey **et al.** (2011), Nair (2011), Baldau and Jaiswal (2014), Dash and Barik (2015), Barik **et al.** (2015), Rout and Barik (2016), Bhuyan and Barik (2017) Sahu and Barik (2017) and many others. However, very little work has been done so far on the floral diversity of grassland community, especially in the North – East region of the state, Odisha. Keeping all these facts in view, an attempt has been made to study the phytodiversity of a grassland community in this region.

Aim of the Study

The aim and objectives of this investigation is to find out the phytodiversity of a grassland community of Mayurbhanj district in Odisha with special reference to human welfare.

Study site and Environment

The experimental site was selected at Ambadiha (86°33'E ; 21°35'N) which comes under Kaptipada subdivision in the district of Mayurbhanj, Odisha. The site is about 5 kms from Udala and 53 kms from Baripada, the district head quarter of Mayurbhanj, Odisha.

The climatic condition of the experimental site was monsoonal with three distinct seasons i.e. summer (March to June), rainy (July to October) and winter (November to February). The total rainfall during the study period was found to be 1594.8 mm, of which a maximum of 379.4mm was recorded during August. The mean minimum and mean maximum atmospheric temperature recorded during the study period were found to be normal throughout the year. January showed the minimum temperature (8.6°C) whereas April exhibited the maximum temperature (45.3°C). Table-1, reveals the monthly mean minimum and mean maximum atmospheric temperature, rainfall and number of rainy days of the experimental site during the study period.

Table-1: Monthly rainfall, mean minimum and mean maximum atmospheric temperature of the experimental site during the study period.

Month	Atmospheric temperature (°C)		Number of rainy days	Rainfall (mm)
	Mean minimum	Mean maximum		
Jan. 2016	8.6	30.5	1	1.8
Feb. 2016	12.0	37.5	4	30.8
Mar. 2016	19.6	37.6	3	13.2
Apr. 2016	22.0	45.3	2	31.2
May 2016	20.5	44.0	13	107.0
Jun. 2016	22.4	40.4	15	274.0
Jul. 2016	23.0	34.6	15	272.0
Aug. 2016	21.6	34.5	20	379.4
Sep. 2016	20.0	33.6	20	326.2
Oct. 2016	18.6	34.8	7	152.6
Nov. 2016	14.0	31.0	1	6.6
Dec. 2016	11.0	28.4	-	-
Total			101	1594.8

The soil of the experimental site was found to be highly acidic (pH range varies from 5.12 to 5.38). The percentage of organic carbon, available phosphorus and potassium contents in the soil were found to be low in proportion. The available phosphorus and potassium contents in the soil were found minimum at upper surface and gradually increased with the increase in soil depth (Table-2).

Table-2 The pH, conductivity, organic carbon (%), available phosphorus and potassium content of the soil of the study site (n=5 each).

Surface depth in cm	pH	Conductivity	Organic carbon (%)	Available phosphorus (ppm)	Available potassium (ppm)
0-10	5.12	0.4	0.39	5.8	46
10-20	5.22	0.4	0.34	5.96	60.8
20-30	5.38	0.44	0.24	6.76	93.2

Materials and Methods

The plant specimens preferably along with reproductive parts were collected from the experimental grassland and brought to the laboratory for identification (Muller Dombois and Ellenberg, 1974). Identification of all the species were made in consultation with various regional and national floras i.e. The Botany of Bihar and Orissa (Haines, 1921-25), Supplement to the Botany of Bihar and Orissa (Mooney, 1950), Flora of Madras Presidency (Gamble, 1915-36), Flora of Simlipal (Saxena and Brahmam, 1989), Flora of Bilaspur District (Panigrahi and Murti, 1989), Flora of Orissa (Saxena and Brahmam, 1994-96), Flora of Madhya Pradesh (Verma **et al.** 1993, Mudgal **et al.** 1997 and Singh **et al.** 2001). The herbarium specimens were prepared following standard methodology as proposed by Jain and Rao (1977). The voucher specimens were preserved and housed in the Herbarium, P.G. Department of Botany, North Orissa University, Baripada, Odisha for future use and reference.

The traditional knowledge about the plants were collected from the nearby village practitioner those who used such plants for different occasion and for the treatment of various ailment, the village baidyas, the Ayurvedic practitioners and from the local inhabitants and incorporated in this investigation.

For the analysis of soil, soil samples were collected from three different depths i.e. 0 to 10, 10 to 20 and 20 to 30 cm with the help of a soil corer. Five samples were taken from each depth, labeled and were mixed thoroughly in order to make a composite soil sample. The samples were dried in the open, rolled and sent to the soil testing laboratory, Department of Agriculture, Government of Odisha, District headquarter branch, Mayurbhanj, Baripada for the determination of soil pH, organic carbon, available phosphorus and potassium content of the experimental site.

The meteorological data i.e. rainfall, number of rainy days and atmospheric temperature were collected from District Agriculture Office, Mayurbhanj, Baripada and are incorporated in this investigation.

Results and Discussion

Table – 3, reveals the list of species and their families occurring in the experimental grassland community during the study period. The community comprised with 33 species, of which 18 species were grasses and 15 species were non grasses. The taxa in the community belong to 28 genera and are grouped under 9 families. The non-grass family comprised of Amaranthaceae (single species), Commelinaceae (two species), Cyperaceae (six species), Asteraceae (single species), Euphorbiaceae (single species), Fabaceae (single species), Rubiaceae (Two species) and Scrophulariaceae (single species). The topography, climatic conditions and biotic interference might be responsible for variation in species composition in the grassland community.

Table 3. List of species and their families occurring in the experimental grassland community during the study period.

Sl.no	Name of the species	Family
Grasses		
1	<i>Alloteropsis cimicina</i> (L.) Stapf	Poaceae
2	<i>Bothriochloa pertusa</i> (L.) A. Camus	Poaceae
3	<i>Brachiaria ramosa</i> (L.) Stapf	Poaceae
4	<i>Brachiaria reptans</i> (L.)	Poaceae
5	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Poaceae
6	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae
7	<i>Dactyloctenium aegyptium</i> (L.) P. Beauv.	Poaceae
8	<i>Eragrostis gangetica</i> (Roxb.) Steud.	Poaceae
9	<i>Eragrostis unioides</i> (Retz.) Nees ex Steud.	Poaceae
10	<i>Ischaemum indicum</i> (Houtt.)	Poaceae
11	<i>Ischaemum rugosum</i> Salisb.	Poaceae
12	<i>Oplismenus burmannii</i> (Retz.)P.Beauv.	Poaceae
13	<i>Panicum walense</i> Mez.	Poaceae
14	<i>Paspalidium flavidum</i> (Retz.) A. Camus.	Poaceae
15	<i>Paspalum scrobiculatum</i> L.	Poaceae
16	<i>Sacciolepis indica</i> (L.)	Poaceae
17	<i>Setaria pumila</i> Roem. & Schult.	Poaceae

18	<i>Sporobolus indicus</i> (var.-diander) (L.) R. Br.	Poaceae
Non-grasses		
1	<i>Alternanthera sessilis</i> (L.) R. Br. ex DC.	Amaranthaceae
2	<i>Commelina paludosa</i> Bl. Enum.	Commelinaceae
3	<i>Cyperus pumilus</i> L.	Cyperaceae
4	<i>Cyperus rotundus</i> L.	Cyperaceae
5	<i>Cyperus triceps</i> Endl.	Cyperaceae
6	<i>Eclipta prostrata</i> (L.) L.	Asteraceae
7	<i>Euphorbia rosea</i> Retz.	Euphorbiaceae
8	<i>Fimbristylis dichotoma</i> (L.) Vahl	Cyperaceae
9	<i>Fimbristylis ovata</i> (Burm.f.) Kern	Cyperaceae
10	<i>Fuirena ciliaris</i> (L.) Roxb.	Cyperaceae
11	<i>Hedyotis herbacea</i> L.	Rubiaceae
12	<i>Lindernia crustacea</i> (L.) F.v. Muell	Scrophulariaceae
13	<i>Smithia conferta</i> J.E.Sm.	Fabaceae
14	<i>Spermacoce raminii</i> Sivar & Nair	Rubiaceae
15	<i>Tonningia axillaris</i> (L.) Kuntze.	Commelinaceae

The community exhibited 21 medicinal species mostly used for the treatment of kidney disorders, rheumatism, snake bites, intestinal round worms, leucoderma, bronchitis, piles, asthma, bleeding, inflammation, acceleration of child birth, dysentery sore feet, coetaneous and subcutaneous parasitic infection, venomous stings / bites, pain, diabetes, various sexual diseases like premature ejaculation, gonorrhoea etc, hepatitis, scabies, cuts, wounds and boils, menstrual disorders, fever, diarrhea, hair fall, dysuria blood dysentery, blood vomiting, various gastrointestinal disorders, hypertension, dropsy, anaemia, diphtheria, jaundice, dyspepsia, flatulence and many other maladies and 17 fodder species. Besides, a few of them are used as forage (10 species), both fodder and forage (7 species), famine food (8 species), revegetating eroded land (2 species), creating lawn (3 species), Green vegetable (3 species), good ground cover (5 species), religious purposes (2 species) and making mats, hats etc (4 species). Most of the species are soil binder and help in controlling soil erosion. The detail of medicinal and other uses of taxa occurring in the experimental site is enumerated as follows.

GRASSES

1. Alloteropsis cimicina (L.) Stapf

Family: Poaceae

Medicinal Uses: Not known

Other Uses : Before flowering the plant is used as fodder and forage. It also helps in erosion control and re-vegetating eroded land.

2. Bothriochloa pertusa (L.) A. Camus

Family: Poaceae

Medicinal Uses: Not known

Other Uses : Before flowering the plant is used as fodder and forage. It also helps in erosion control, creating lawns, creating good ground cover, re vegetating eroded land, lining flood ways, stabilizing and re vegetating mine waste areas.

3. Brachiaria ramosa (L.) Stapf

Family: Poaceae

Medicinal Uses: Not known

Other Uses : The seeds are edible at the time of food scarcity. The plant helps in erosion control. Fodder (both in fresh and hay)

4. Brachiaria reptans (L.) Gardner & Hubb.

Family: Poaceae

Medicinal Uses : Rhizomes are diuretic. A paste made from the rhizome is used in the treatment of kidney disorder.

Other Uses : Seeds are edible (Famine food)

5. *Chrysopogon aciculatus* (Retz.) Trin.**Family :** Poaceae**Medicinal Uses :** Ashes of the plant is used for treatment of rheumatism. A decoction of the roots is used to treat poisonous snake bites. Seeds are used to expel intestinal roundworms.**Other Uses :** The plants are used in creating lawns, creating dense ground cover and controlling soil erosion. Straw is used for weaving mats, hats etc.**6. *Cynodon dactylon* (L.) Pers.****Family :** Poaceae**Medicinal Uses :** The plant is used as first aid for minor injuries. The plant is effective for the treatment of leucoderma, bronchitis, piles, asthma, tumors, and enlargement of the spleen. It is also used to treat all types of bleeding and skin troubles.**Other Uses :** Binding soil, creation of lawns, religious purposes, fodder.**7. *Dactyloctenium aegyptium* (L.) Willd.****Family :** Poaceae**Medicinal Uses :** The plant is analgesic, anthelmintic, anti-inflammatory, antipyretic, astringent and diuretic. An infusion of the leaves, mixed with the seeds of *Cajanus cajan*, is used to accelerate childbirth. A decoction of the leaves, combined with *Scoparia dulcis*, is used as a remedy for dysentery.**Other Uses :** Seeds are edible (Famine food)**8. *Eragrostis gangetica* (Roxb.) Steud.****Family :** Poaceae**Medicinal Uses :** A decoction of the plant is used for the treatment of sore feet.**Other Uses :** Seeds are edible (Famine food)**9. *Eragrostis uniolooides* (Retz.) Nees ex Steud****Family :** Poaceae**Medicinal Uses :** Not known**Other Uses :** Forage/fodder, green mature**10. *Ischaemum ciliare* (Retz.)****Family :** Poaceae**Medicinal Uses :** Not known**Other Uses :** The plant is used as fodder. It is also used as cover grass to bind soil and reduce erosion.**11. *Ischaemum rugosum* Salisb.****Family :** Poaceae**Medicinal Uses :** Not known**Other Uses :** Forage, composting, seeds are eaten and are edible at the time of food scarcity.**12. *Oplismenus burmannii* (Retz.) P.Beauv.****Family :** Poaceae**Medicinal Uses :** Leaves are used for the treatment of cutaneous and subcutaneous parasitic infection, venomous stings, bites etc. It is generally used as pain killers.**Other Uses :** Soil binder, fodder, religious purposes.**13. *Panicum walense* Mez.****Family :** Poaceae**Medicinal Uses :** Not known**Other Uses :** Fodder, creating dense ground cover, grains are edible.**14. *Paspalidium flavidum* (Retz.) A. Camus****Family :** Poaceae**Medicinal Uses :** The leaves are antiseptic and their paste is applied externally in cutaneous affections.**Other Uses :** Seeds are edible (at the time of scarcity of food), Fodder. (It is eaten by horses and cattle) forage.**15. *Paspalum scrobiculatum* L.****Family :** Poaceae**Medicinal Uses :** The leaves are antiseptic in action. The leaf paste is applied externally in cutaneous affections. Leaves are also used for carbuncle, diabetes, intoxication, narcotics, ophthalmia, parturition and sores.**Other Uses :** The plant is used as forage and fodder for life stock. Seeds are edible, cooked like rice and also used for preparing bread.**16. *Sacciolepis indica* (L.) Chase****Family :** Poaceae**Medicinal Uses :** Not known**Other Uses :** Fodder before flowering, control soil erosion**17. *Setaria pumila* Roem. & Schult.****Family :** Poaceae**Medicinal Uses :** Not known**Other Uses :** Seeds are edible, fodder, made into good hay, control soil erosion.**18. *Sporobolus indicus* (L.) R. Br.****Family :** Poaceae**Medicinal Uses :** The plant is used to enrich the blood, reduce swellings and treat gonorrhoea.**Other Uses :** Seeds are edible (famine food), forage (before flowering), controlling soil erosion, culms/straw are used for weaving hats, hand fans and other items.**NON-GRASSES****1. *Alternanthera sessilis* (L.) R. Br. ex DC.****Family :** Amaranthaceae**Medicinal Uses :** The plant is said to be galactagogue, cholagogue, abortifacient, febrifuge, diuretic and laxative. The plant is used to treat hepatitis, bronchitis, asthma and other lung troubles and to stop bleeding.

The plant paste is also applied externally in the treatment of scabies, cuts and wounds and boils. Mixed with corn flour and baked, it is eaten to treat menstrual disorders. An infusion of the entire plant is used as a remedy against intestinal cramps, fever, diarrhoea and dysentery. The plant is used as an ingredient in making hair oils to prevent hair fall and in the preparation of Kajal. The juice of the root is used in the treatment of dysuria, fevers and blood dysentery. Decoction of plant with some salt is taken to stop blood vomiting. The plant/leaf sap is used for the treatment of gastrointestinal disorders, chronic liver congestion and gonorrhoea. Intake of plant sap is very useful for the treatment of hypertension.

Other Uses : Tender leaves and young shoots are eaten as salad/cooked vegetable/soup

2. *Commelina paludosa* Bl. Enum.

Family : Commelinaceae

Medicinal Uses : The plant is refrigerant and laxative. It is useful in strangury and costiveness. The root is useful in vertigo, fevers and bilious affections. The leaf juice is used for the treatment of dysentery.

Other Uses : Forage

3. *Cyperus pumilus* L.

Family : Cyperaceae

Medicinal Uses : Not known

Other Uses : Control soil erosion

4. *Cyperus rotundus* L.

Family : Cyperaceae

Medicinal Uses : The plant is anti-microbial, anti-malarial, anti-oxidant, and anti-diabetic. It is used for treating fevers and digestive system disorders. Roasted tubers powder or hot ashes from burned tubers, is used to treat wounds, bruises, carbuncles, etc. The antibacterial properties of the tubers prevent tooth decay.

Other Uses : The well dried grass is used in making sleeping mats.

5. *Cyperus triceps* Endl.

Family : Cyperaceae

Medicinal Uses : The plant is used for treating diabetes and fever.

Other Uses : Soil binder

6. *Eclipta prostrata* (L.) L.

Family : Asteraceae

Medicinal Uses : Leaf sap is used internally in the treatment of dropsy and liver disorder, Anaemia and diphtheria. It prevents premature tooth loss and premature greying of hair. Externally, the plant is used as an oil to treat hair loss and is also applied to treat skin disorders, eczema, dermatitis, and wounds. It is applied to cuts, bruises and sores in order to stop bleeding and relieve pain. The plant juice is also used in the treatment of jaundice. The leaves are used to treat fevers, eye diseases, asthma, bronchitis, liver problems, diarrhoea and weak bladder. A decoction is used to treat cancer. The leaves are used in the treatment of scorpion stings and as an antidote for snake bites.

Other Uses : Green leaves are used in preparation of chutneys. Tender leaves and young shoot (cooked) are used as vegetable. Juice extracted from whole plant or leaves are used as a hair dye and for tattooing.

7. *Euphorbia rosea* Retz.

Family : Euphorbiaceae

Medicinal Uses : The plant is diuretic, laxative and antiviral. The plant is used for breathing disorders including asthma, bronchitis and chest congestion. Leaf sap is used to treat nasal mucus, throat spasms, dysentery, diarrhoea, skin irritation, inflammations like conjunctivitis, worms, sexual diseases like premature ejaculation, gonorrhoea. Intakes of decoction of leaf initiate milk production in lactating mothers. It is also said to be used to treat snake bites.

Other Uses : Soil binder

8. *Fimbristylis dichotoma* (L.) Vahl

Family : Cyperaceae

Medicinal Uses : The rhizomes are aromatic, diuretic and its pastes are taken to treat kidney disorder. The rhizomes are collected and trade for their aromatic properties.

Other Uses : It is grown on slope stabilization and is harvested as fodder for cattle. The culms / stems are used for making mats. Green manure and control soil erosion.

9. *Fimbristylis ovata* (Burm.f.) Kern

Family : Cyperaceae

Medicinal Uses : The plant is anti-inflammatory, antioxidant and is used as blood purifier. The flowering stems are plaited to make bangles and placed on the wrist. It is believed to be relieve rheumatism.

Other Uses : Fodder, control soil erosion.

10. *Fuirena ciliaris* (L.) Roxb

Family : Cyperaceae

Medicinal Uses : Not Known

Other Uses : Before flowering the plant is used a fodder and forage. It also helps in erosion control

11. *Hedyotis herbacea* L.

Family : Rubiaceae

Medicinal Uses : Whole plant is useful in elephantiasis, verminosis, dyspepsia, flatulence, colic inflammations, ulcers and hydrocele. Leaves are used for the treatment of jaundice, rheumatism, asthma, bronchitis, fever and also in snake bite.

Other Uses : Erosion control.

12. *Lindernia crustacea* (L.) F. Muell

Family : Linderniaceae

Medicinal Uses : The whole plants / leaves are used for the treatment of bilious disorders, enteritis-diarrhoea and indigestion, dysentery, amenorrhoea, hepatitis and laprosy. The powdered plant mixed with rice water, is taken internally to cure diarrhoea, vomiting and cholera. A decoction of the leaves is given to mother as a medicine after childbirth. A decoction is taken as a tea for its febrifuge effect. The leaf decoction is applied topically to boils and itches and herpes-like sores. The juice of the aerial parts of the plant, mixed with turmeric powder and heated with a little water, is applied topically to treat infected fingernails. The plant is also used for snake and tick bites.

Other Uses : Control soil erosion.

13. *Smithia conferta* J.E.Sm.

Family : Fabaceae

Medicinal Uses : The plant is laxative. It is used to cure biliousness and rheumatism. It is also used to cure sterility in women.

Other Uses : Tender leaves are used as vegetable.

14. *Spermacoce raminii* Sivar & Nair

Family : Rubiaceae

Medicinal Uses : Not Known

Other Uses : Young shoot are grazed by cattle. Plants are helpful in controlling soil erosion.

15. *Tonningia axillaris* (L.) Kuntze.

Family : Commelinaceae

Medicinal Uses : The whole plant is used to treat swellings, rheumatism and joint pain.

Other Uses : In times of famine, seeds are edible and eaten like cereal. The whole plant is a good forage and fodder.

Conclusion

The phytodiversity of a grassland community of Ambadiha in the district of Mayurbhanj, Odisha was rich in grasses, sedges and other associated herbs and shrubs. The community comprised of maximum number of medicinal species. A few of them are used as fodder, forage, green vegetables, manure, good ground cover, re-vegetating eroded land, erosion control, creating lawns and making mats and hats and need conservation for the betterment of human welfare. The taxa in the grassland community vary from place to place and from time to time depending upon the topography, climatic conditions and biotic interference of the locality.

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References

1. Ambasht, R.S. & A.N.Maurya (1970) : Reproductive capacity of *Dichanthium annulatum* in relation to biotic factors. *Trop. Ecol.*, 10 (2); 186-193.
2. Baldau, P.D. and M.L. Jaiswal (2014) : A study of primary productivity on grassland of Bilaspur district, Chhatisgarh, India. *Int. J. Sci. Res.*, 4:1-4.
3. Barik, K.L., A.K.Biswal, U.B.Mohapatra & J.R.Sahu (2015) : Floral diversity of a grassland community of Similipal Biosphere Reserve. *Global J. Environ. Sci. & R e s .* , 2 (3) : 87 - 91.
4. Barik, K.L. & B.N. Misra (1998) : Biological spectrum of a grassland ecosystem of South Orissa. *Ecoprint*, 5(1); 73-77
5. Batalha, M.A. & F.R. Martins (2004) : Floristic, frequency and vegetation – lifeform spectra of a Cerrado site. *Braz.J.Biol.*, 64(2);203-209.
6. Bhuyan, D.L. & K.L. Barik, (2017) : Assessment of floral diversity of a grassland community of Kaptipada forest range of Mayurbhanj district in Odisha, India, *Int. J. Sci. Res.* 6 (2) ; 663-665.
7. Choudhury, V B. (1964): Seasonal changes in the standing crop, annual, net production and energetics of *Dichanthium annulatum* Stapf, Ph. D. Thesis. BHU, Varanasi.
8. Dash, A. & K.L. Barik, (2015). Net Primary Production of a Grassland Community of Mayurbhanj District in Odisha, India, *Indian, J. Appl. Res.* 5 (7) ; 56-58.
9. Ejrnaes, R. & H.H. Bruun (2000) : Gradient analysis of dry grassland vegetation in Denmark. *J.Veg.Sci.*, 11, 573-584
10. Gamble, J.S. (1915-36) : Flora of the Presidency of Madras. Adlar & Son Ltd., London.
11. Ghani, M. M. A. & K. N. A. Khalik (2006) : Floristic diversity and phytogeography of the Gebel Elba National Park. South-East Egypt. *Turk.J.Bot.* 30; 121-136.
12. Haines, H.H. (1921-25): The Botany of Bihar and Orissa. Adlar & Son Ltd., London.
13. Jain S.K. and Rao R. (1977). A handbook of field and herbarium methods. Today & Tomorrows Printers and Publishers, New Delhi.
14. Kar, P.K., A.K. Biswal and K.L. Barik. (2010) : Floristic composition and Biological spectrum of a grassland community of Rangamatia in the district of Mayurbhanj, Odisha. *J. Curr. Sc.* 15 (2): 465 - 469.
15. Misra, M.K. & B.N. Misra (1984) : Biomass and primary production in an Indian grassland *Trop. Ecol.*, 25; 239-247.
16. Misra, M.K & B.N. Misra (1986) : Net primary production and diversity in the grassland of Berhampur, Orissa. *Ind. J. For.*, 9 (2); 146-150.
17. Monney, H.F.(1950) : Supplement to Botany of Bihar and Orissa, Catholic Press, Ranchi.
18. Mudgal,V., K.K. Khanna & P.K. Hajra-eds (1997) : Flora of Madhya Pradesh, Vol-II, Botanical Survey of India, Calcutta.
19. Mueller-Dombois, D. & H. Ellenberg (1974) : Aims and methods of vegetation ecology, John, Willey and Sons, New York.
20. Nair, R (2011). Floristic study of Dadra and Nagar Haveli, *Life Sci. leaflets*, 20 ; 872-875.
21. Odum. E.P. (1960) : Organic production and turnover in old field succession, *Ecology*, 41; 39-49.
22. Pandey, D.D, K. Pandey & S.S. Kumar (2011) : Phytosociological Studies of Grassland in the Vicinity of Pataratu thermal power, Hazaribagh, Jharkhand, *J. Phytology*, 3 (12) ; 63-66.
23. Panigrahi, G. & S.K. Murti (1989) : Flora of Bilaspur District, MP. Vol. 1, Botanical Survey of India, Calcutta.
24. Patel, P.K. & M.K. Patel (2010) : Folklore value of weeds grown in the wasteland of Kadi, Gujarat, *Life Sci. Leaflets*, 1 ; 1-6.
25. Rahim, S.M.A, S. Hasnain, A.R. Shamsi & F. Jabeen (2011) : The Phytosociological analysis of saline area of Tehsil Ferozewala District Sheikhpura (Punjab), Pakistan. *Afri. J. Environ. Sci. & Tech.* ; 5(4) ; 316-326.
26. Redmann, R.E.(1975) : Production Ecology of grassland communities in Western North Dakota, *Ecol.Monogr.*, 45; 83-106.
27. Risser, P.G. (1995) : Indicators of grassland sustainability-a first approximation, In: Munasinghe, M. and Shearer, W. (eds.), *Defining and measuring sustainability*, Washington D.C., 309-319.
28. Rout P.K. & K.L. Barik (2016) : Above ground biomass of a grassland community of Bangriposi, Mayurbhanj, Odisha. *Global J. of Environ. Sci. & Res.* 3 (2); 85-89.
29. Sahu J. R. & K.L. Barik (2017) : Life forms and biological spectrum of a grassland

- community of Similipal Biosphere Reserve, *Periodic Research.* 5(3) ; 11-14.
30. Sant, R. (1962) : A study of the reproductive capacity of some grasses and forbs of the grounds of the Banaras Hindu University. Ph. D Thesis. BHU.
31. Sant. H.R.(1965) : Ecological studies in *Dichanthium annulatum* Stapf, with special reference to reproductive capacity in relation to grazing. *Proc. Nat. Inst. Sci.* 30 (B) ; 354-372.
32. Saxena, H.O. & M.Brahmam (1989) : The Flora of Similipal, Orissa, Regional Research Laboratory (CSIR), Bhubaneswar.
33. Saxena, H.O. & M.Brahmam (1994-96) : The flora of Orissa, Vol. I-IV, Regional Research Laboratory (CSIR), Bhubaneswar, and Forest Development Corporation Ltd. Bhubaneswar, Orissa.
34. Singh, J.S.(1967) : Seasonal variation in composition, plant biomass and net community production in the grassland at Varanasi, Ph.D. Thesis, BHU, Varanasi.
35. Singh, N.P., K.K Khanna, V. Mudgal & R.D. Dixit-eds (2001) : Flora of Madhya Pradesh, Botanical Survey of India. Vol-III, Calcutta.
36. Singh. U.N. & R.S. Ambasht (1980) : Floristic composition and phytosociological analysis of three grass stands in Naugarh Forest of Varanasi Division, *Ind.J.For.*, 3 (2): 143-147.
37. Tripathy. P.C. (1989) : Effect of chipping and fertilization on the structure and function of a grassland ecosystem, Ph D. Thesis, Berhampur University, Berhampur, Orissa. India.
38. Verma, D.M., N. P. Balakshnan & R.D. Dixit-eds (1993). Flora of Madhya Pradesh, Vol-I, Botanical Survey of India, Calcutta.