7. DISCUSSIONS

7.1. General enumeration of Aquatic and Marshy land angiosperms:

The position of the district Paschim Medinipur helps to gather huge aquatic and marshy land plants with rich ecological diversity. Out of total 160 angiosperms, 92 plant species are monocot and 68 plant species are dicot. Among these 15 are monocot families, 3 with single species viz. Amaryllidaceae with *Crinum asiaticum*, Xyridaceae with *Xyris indica*, and Zingiberaceae with *Alpinia aquatica*. Poaceae is the most dominant families with containing 18 genera and 28 species, followed by Cyperaceae with 9 genera and 23 plant species, Hydrocharitacea with 6 genera and 10 species, Alismataceae with 4 genera and 5 species, Commelinaceae with 3 genera and 5 species, Eriocaulaceae with 4 species. The rest of 6 families contain below the 4 species. Most dominated monocot with 9 plant species documented under the genus *Cyperus*, followed by *Blyxa* and *Eriocaulon* with 4 species, *Fimbristylis*, *Isachne*, *Eleocharis*, and *Brachiaria* with 3 species. (Table 46-48)

Table 46. Numerical analysis of species distribution.

Life forms	No. of Family	No. of Genus	No. of Species
Monocotyledons	15	54	92
Dicotyledones	28	39	68
Total	**43**	**93**	**160**

Table 47. The ratio of Monocotyledons and Dicotyledons as revealed by the study.

Ratio	Family	Genus	Species
Monocotyledons/ Dicotyledons	1: 1.87	1.38:1	1.35:1

Among 28 dicot families Asteraceae with a maximum 4 genera and 5 species, followed by Lythraceae and Plantaginaceae with 3 genera 5 species, Lentibulariaceae with 1 genus and 5

species, Fabaceae with 2 genera and 4 species, Rubiaceae 2 genus and 4 species, Onagraceae with 1 genus and 4 species. Total 12 families are containing single genus (Table-3, 4), 12 families are monospecific such as Apiaceae with *Centella asiatica*, Balsaminaceae (Ba) with *Hydrocera triflora*, Ceratophyllaceae (Ce) with *Ceratophyllum demersum*, Droseraceae (Dr) with *Drosera burmannii*, Elatinaceae with *Bergia capensis*, Haloragaceae (Ha) with *Myriophyllum indicum*, Hydroleaceae (Hy) with *Hydrolea zeylanica*, Mimosaceae (Mi) with *Neptunia oleracea*, Nelumboaceae (Ne) *Nelumbo nucifera*, Ranunculaceae (Ra) *Ranunculus sceleratus*, Sphenocleaceae (Sp) with *Sphenoclea zeylanica* and Verbinaceae (Ve) with *Phyla nodiflora*. (Table 46-48)

Table 48. List of Angiospermic families according to their predominance on the basis of their total number of genera and species.

Life forms	Based on the number of genera	Based on the number of species
Monocotyledons	Poaceae (18)	Poaceae (28)
	Cyperaceae (09)	Cyperaceae (23)
	Hydrocharitacea (06)	Hydrocharitacea (10)
	Alismataceae (04)	Commelinaceae (05)
		Alismataceae (05)
Dicotyledones	Asteraceae (04)	Asteraceae (05)
	Lythraceae (03)	Lentibulariaceae (05)
	Plantaginaceae (03)	Lythraceae (05)
		Plantaginaceae (05)

The family ratio of Monocotyledons and Dicotyledons as revealed by the study is 1: 1.87, the genus ratio is 1.38:1, and the Species ratio is 1.35:1. Dicotyledons families are most dominant than the Monocotyledons, but genera and species are more dominant in Monocotyledons than Dicotyledons (Table 47).

7.2. Growth forms of monocot:

Among these 92 monocots, plant species maximum 36 are Emergent Anchored plants recorded and followed by 33 Marshland plants, 12 Submerged Anchored plants. Five (5) species Rooted with Floating Leaved plants and 6 species with Free Floating plants. Some common monocot plants present in these aquatic regions, such as *Brachiaria eruciformis*, *Brachiaria mutica*, *Chloris barbata*, *Colocasia esculenta*, *Commelina benghalensis*, *Commelina diffusa*, *Cyanotis axillaris*, *Cyperus compactus*, *Cyperus compressus*, *Cyperus platystylis*, *Cyperus difformis*, *Cyperus iria*, *Echinochloa crus-galli*, *Eleocharis dulcis*, *Eriocaulon cinereum*, *Fimbristylis dichotoma*, *Hydrilla verticillata*, *Kyllinga brevifolia*, *Kyllinga tenuifolia*, *Lemna trisulca*, *Monochoria hastate*, *Paspalum scrobiculatum*, *Pistia stratiotes*, *Saccharum spontaneum*, *Spirodela polyrrhiza* and *Xyris indica* (Table-2, Graph-5).

7.3. Growth forms of dicot:

Among the 68 dicots, maximum 22 Emergent Anchored plants recorded and followed by 28 Marshland plants, 12 rooted with Floating Leaved plants and 6 Submerged Anchored plants. Some common Dicot plants present in these aquatic regions. Such as *Aeschynomene aspera*, *Alternanthera philoxeroides*, *Alternanthera sessilis*, *Dentella repens*, *Eclipta prostrata*, *Grangea maderaspatana* , *Heliotropium indicum*, *Hydrolea zeylanica*, *Hygrophila difformis*, *Ipomoea aquatica*, *Ipomoea fistulosa*, *Limnophila heterophylla*, *Ludwigia adscendens*, *Ludwigia perennis*, *Myriophyllum indicum*, *Nymphaea nouchali*, *Nymphaea pubescens*, *Nymphoides hydrophylla*, *Oldenlandia corymbosa*, *Phyla nodiflora*, *Persicaria orientalis*, *Persicaria hydropiper*, *Rotala densiflora*, *Sesbania javanica*, *Trapa natans*, *Urticularia aurea* and *Utricularia stellaris* (Table 4, Graph 10).

7.4. A quantitative survey of Monocot:

The highest density was measured among monocot in *Spirodela polyrrhiza* (16.634) followed by *Lemna trisulca* (16.01), *Wolffia globosa* (15.75), *Pistia stratiotes*, *Kyllinga brevifolia*, and *Kyllinga tenuifolia*. On the contrary, the lowest density was measured among monocot *Alpinia aqutica* (0.216) followed by *Blyxa japonica* (0.37), *Arundo donax*, *Blyxa echinosperma* (0.38), *Crinum asiaticum*, *Sagittaria sagittifolia*, and *Caldesia parnassifolia*.

The highest monocot frequency measured in *Leersia hexandra* (78.34%), *Sacciolepis interrupta* (70%), and *Spirodela polyrrhiza* (65%). Lowest frequency value of monocot measured in *Blyxa echinosperma* (5%) followed by *Phragmites karka* and *Potamogeton crispus* (7%).

The highest abundance value has been recorded after analysis in *Wolffia globosa* (93.34) followed by *Spirodela polyrrhiza* (31.96967), *Lemna trisulca* (26.584) and *Eleocharis dulcis* (19.03733), etc. The lowest abundance value has been recorded in *Hygroryza aristata* (3) followed by *Alpinia aqutica* (3.176), *Caldesia parnassifolia* (3.447), *Cyperus imbricatus* (3.867) and *Arundo donax* (3.974).

7.5. A quantitative survey of Dicot:

In dicot highest density was measured in *Grangea maderaspatana* (7.5) followed by *Hygrophila difformis* (7.05), *Nymphaea nouchali*, and *Nymphaea pubescens* (5.15). In dicot, the lowest density measured in followed by *Bergia capensis* (0.1), *Ammannia auriculata* (0.15), and *Ipomoea fistulosa* (0.2).

Among dicot highest frequency values measured in *Nymphaea pubescens* and *Grangea maderaspatana* (60%), followed by 55% in five species such as *Hygrophila difformis, Ludwigia adscendens, Nymphaea nouchali, Rotala densiflora, and Utricularia stellaris*. Lowest frequency value 5% measured in *Ceratophyllum demersum, Alternanthera ficoidea*, and *Drosera burmannii*.

Highest abundance value 19.34 has been recorded after analysis in *Lindernia antipoda* followed by 18.50 values in case of *Limnophila sessiliflora* and *Persicaria orientalis* (14.25) etc. The lowest abundance value has been recorded in *Ludwigia prostrate* (1.5), followed by *Aeschynomene indica* (1.6), *Bergia capensis* (2.0), *and Sesbania javanica* (2.5).

7.6. PC (Principal Component) analysis of the distribution of Monocotyledons:

Species with a similar distributional pattern have come into the same coordinate. In the first coordinates, the species *Phragmites karka* is extremely out-group than the rest of taxa, followed by *Typha elephantina*, *Isachne miliacea,* and *Sagittaria sagittifolia*. The other 18 species in this coordinates patch in two groups. The first patch contains nine (9) species such as *Sacciolepis indica, Saccharum spontaneum, Najas indica, Eriocaulon setaceum, Commelina benghalensis*, *Blyxa octandra*, and others. The second patch contains the rest of 9 species such as *Blyxa echinosperma, Blyxa japonica, Paspalum scrobiculatum, Potamogeton Crispus, Pycreus flavidus, Pycreus polystachyos, Cyperus michelianus* subsp. *pygmaeus, Crinum asiaticum,* and some other aquatic monocot present in the same coordinate due to their similar distributional pattern in this district.

Some species show a similar distributional pattern in the next coordinates with 18 species. Such as *Commelina diffusa, Cyperus compressus, Eriocaulon cinereum, Schoenoplectus juncoides, Panicum repens, Isachne albens, Blyxa aubertii, Cyperus platystylis, Eleocharis geniculate, Cyperus distans, Monochoria hastata, Hydrilla verticillata, Hemarthria*

compressa, and others. Some species are extremely out-group in these coordinates such as *Wolffia globosa*, with high abundance value and followed by *Lemna trisulca*, *Kyllinga brevifolia*. These species are come into the same coordinate due to their similar distributional pattern.

Total 25 species such as *Sagittaria guayanensis* subsp. *lappula*, *Schoenoplectiella articulata, Panicum paludosum, Murdannia spirata, Oryza rufipogon, Murdannia nudiflora, Ottelia alismoides, Najas graminea, Panicum paludosum, Pistia stratiotes, Eleocharis spiralis, Actinoscirpus grossus* and others are placed in next another coordinates with their similar distribution pattern based on density, frequency and abundance values. Two species such as *Sacciolepis interrupta* and *Spirodela polyrrhiza* are highly out-group due to their extreme distribution values. In last coordinates with 27 species such as *Alpinia aqutica, Limnophyton obtusifolium, Caldesia parnassifolia, Butomopsis latifolia, Chrysopogon zizanioides, Vallisneria spiralis, Potamogeton nodosus, Fuirena ciliaris, Cyperus imbricatus, Cyperus iria, Chloris barbata, Brachiaria reptans, Hygroryza aristata* and others are placed due to their same distribution pattern.

Principal Component Analysis (PCA) indicates the characters, the first two PC factors accounted for about 98% of the total variance. The first factor is an account for about 67% of the total variance with the mean density. The second PC factors account for 31% of the total variance, with frequency distribution. The third PC showed a minimum variance (1.7%) with abundance values. (Figure 154-156, Table 49).

Table 49: Summary of Principal component analysis on three variables of 92 monocot plant species

PC	**Eigen value**	**% variance**
1	277.871	67.007
2	129.767	31.293
3	7.05159	1.7004

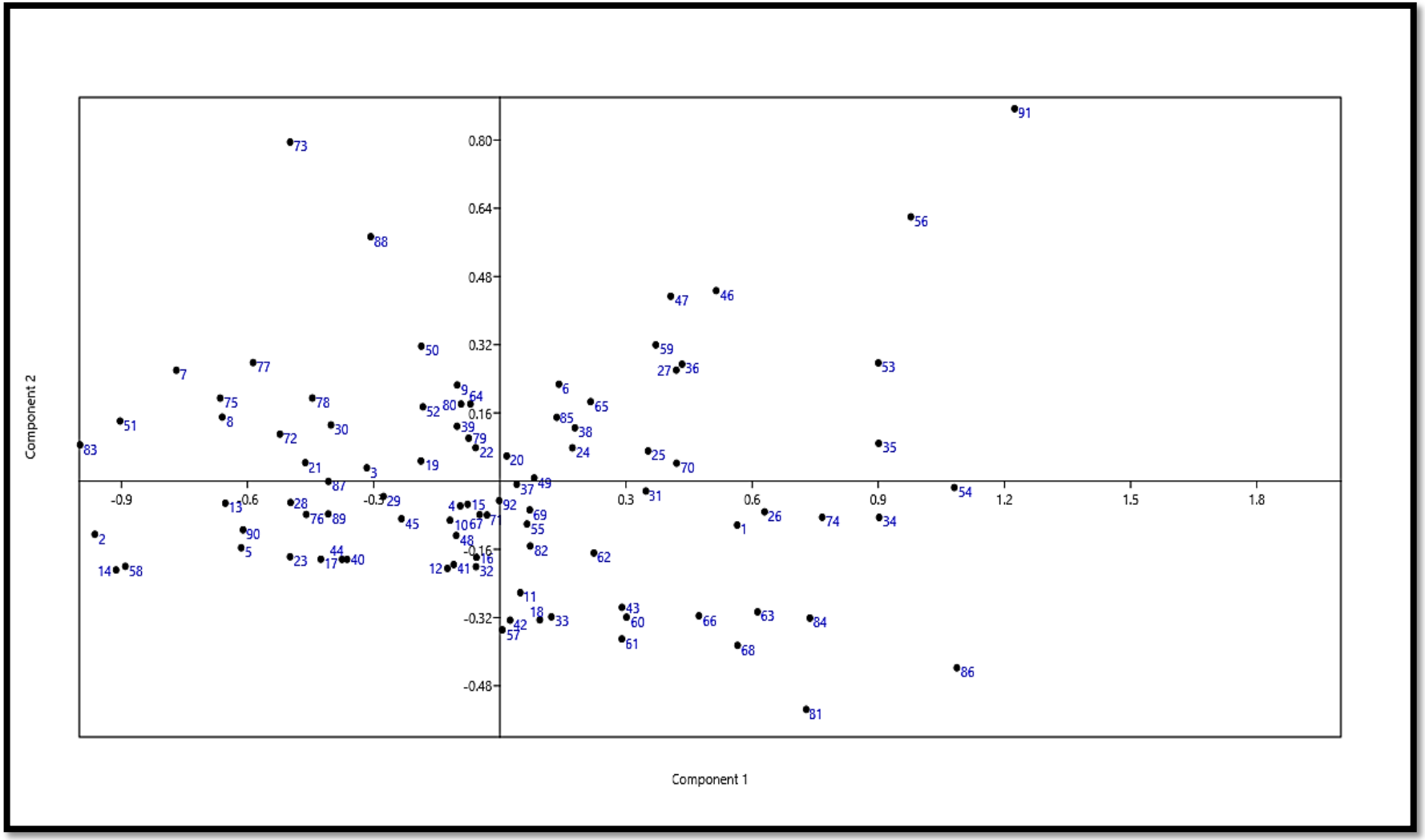


Figure 164: PC (Principal Component) analysis of Monocotyledons based on the distribution (Scatter plot).

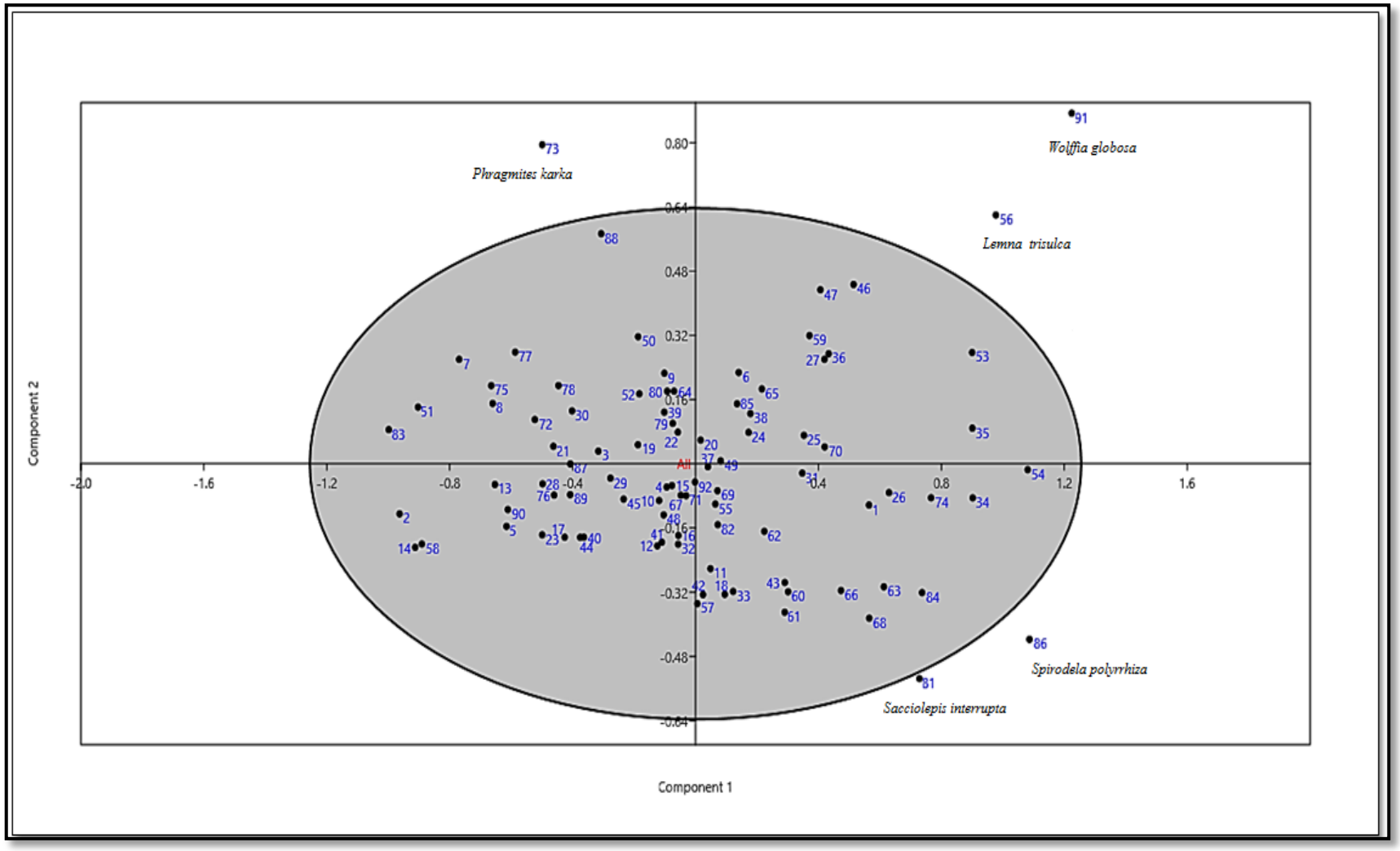
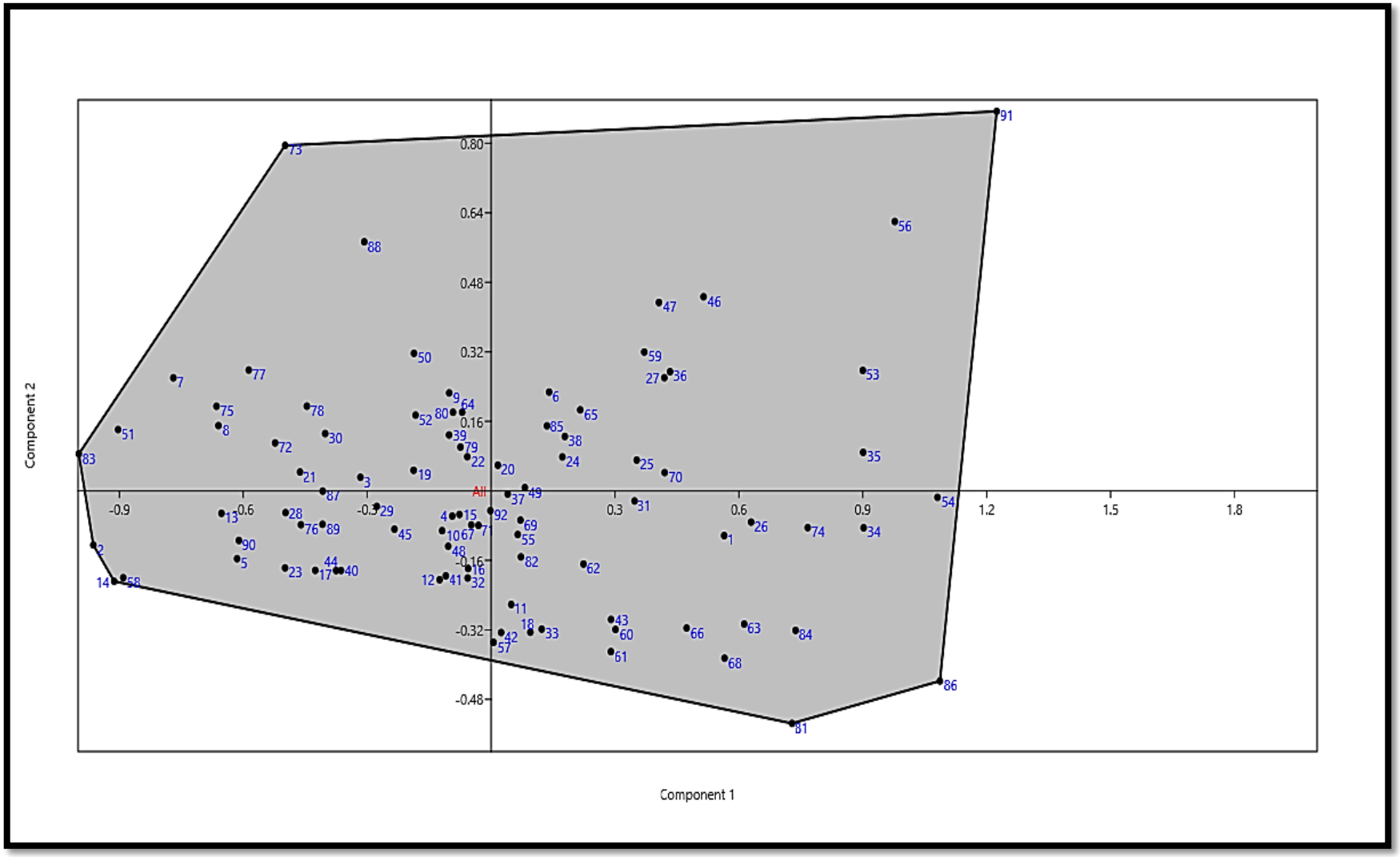


Figure 165: PC (Principal Component) analysis of Monocotyledons based on distribution with 95% ellipses.



166: PC analysis of Monocotyledons based on distribution with convex hulls.

7.7. PC (Principal Component) analysis of the distribution of Dicotyledons:

After principal component analysis (PCA) of 68 dicot plants species are concluded, all species placed in four quadrate based on density, frequency (%) and abundance. Species with a similar distributional pattern have come into the same coordinate. In the first coordinates with a total of 15 plant taxa were placed according to their average density, frequency (%), and abundance value. Among which *Ammannia auriculata* and *Ipomoea fistulosa* are extremely out group, followed by the species *Oldenlandia brachypoda*, *Sphaeranthus africanus*, *Utricularia gibba* and these are placed in a patch. Another 10 species placed in three groups, one of these contains *Ranunculus sceleratus* and *Trapa natans*. The next group contains 3 species such as *Sesbania bispinosa*, *Oldenlandia diffusa*, *Hydrocera triflora,* and another group contain the next 4 species such as *Alternanthera philoxeroides*, *Ceratophyllum demersum*, *Hygrophila polysperma*, *Lobelia alisnoides*.

In second coordinates total 16 species are placed due to their similar distributional pattern. Out of them *Lobelia alisnoides*, *Lindernia ciliate*, *Grangea maderaspatana* are outgroup due to their extreme value and followed by *Lindernia antipoda*, *Lindernia crustacean*, *Hygrophila difformis*. Among the rest of the species placed in different patches, out of them *Persicaria orientalis* , *Polygonum plebeium* are closed to *Lindernia crustacea* and *Myriophyllum indicum, Utricularia aurea*, *Oldenlandia corymbosa*, *Persicaria hydropiper*, *Neptunia oleracea* are patches in another group. Species *Nymphoides indica*, *Enhydra fluctuans* are distributional related and *Limnophila heterophylla* placed in single patches.

In third coordinates total of 20 species are placed due to their similar distributional pattern in this district. Many species in these coordinates placed outside of the coordinates such as *Nymphaea pubescens*, *Nymphaea nouchali*, *Nymphaea rubra*, *Ludwigia adscendens*,

Utricularia stellaris, *Rotala densiflora*, *Ludwigia perennis*, and *Nymphoides hydrophylla*. The species *Phyla nodiflora*, *Sphenoclea zeylanica*, and *Heliotropium ovalifolium* placed in another patch. Rest species are *Hydrolea zeylanica*, *Ipomoea aquatic*, *Eclipta prostrata* and *Coldenia procumbens* placed in these coordinates. In the last coordinates total of 16 species has been placed out of them *Aeschynomene indica*, *Ludwigia prostrate* and *Bergia capensis* are extremely out-group. Rest of the 17 species placed in four patches. One patch contains *Ammannia baccifera*, *Nelumbo nucifera*, and *Utricularia caerulea*. Another patch contains *Hygrophila auriculata*, *Limnophila heterophylla*, *Bacopa monnieri*, and *Heliotropium indicum*. The last two patches contain *Aeschynomene aspera*, *Dopatrium junceum*, *Lobelia zeylanica*, and *Sesbania javanica* and *Utricularia bifida*. All the aquatic dicots present in the same coordinates due to their similar distributional pattern in this district (Figure 157-159, Table 45).

Principal Component Analysis (PCA) indicates the characters, the first two PC factors accounted for about 99% of the total variance. The first factor is an account for about 84% of the total variance with the mean density. The second PC factors account for 15% of the total variance, with frequency distribution. The third PC showed a minimum variance (0.92%) with abundance values. (Figure 157-159, Table 50).

Table 50: Principal component analysis of three variables of 68 Dicot plant species.

PC	**Eigen value**	**% variance**
1	0.309707	84.219
2	0.0546385	14.858
3	0.00339458	0.92309

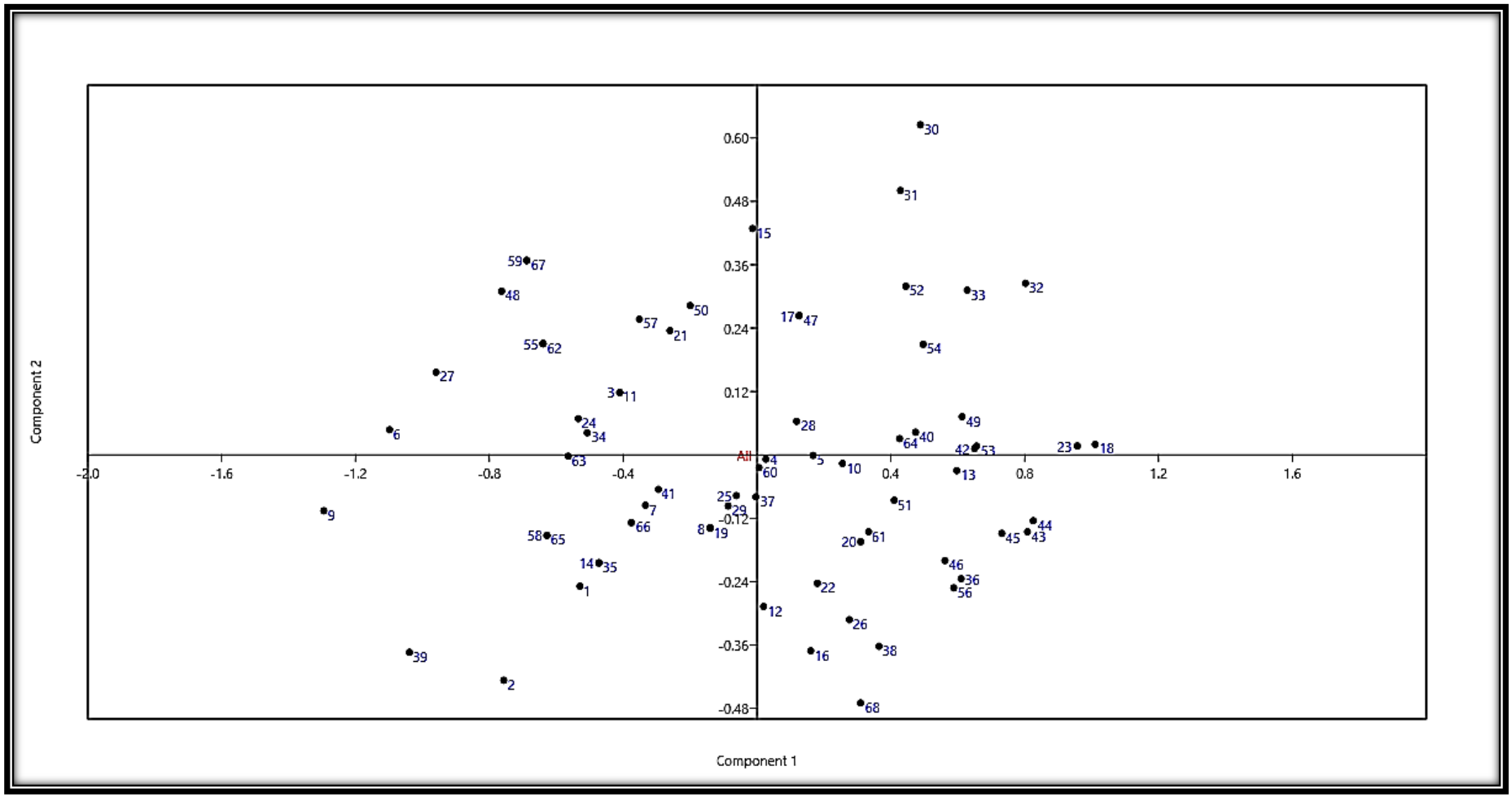


Figure 167: PC (Principal Component) analysis of Dicotyledons based on the distribution (Scatter plot).

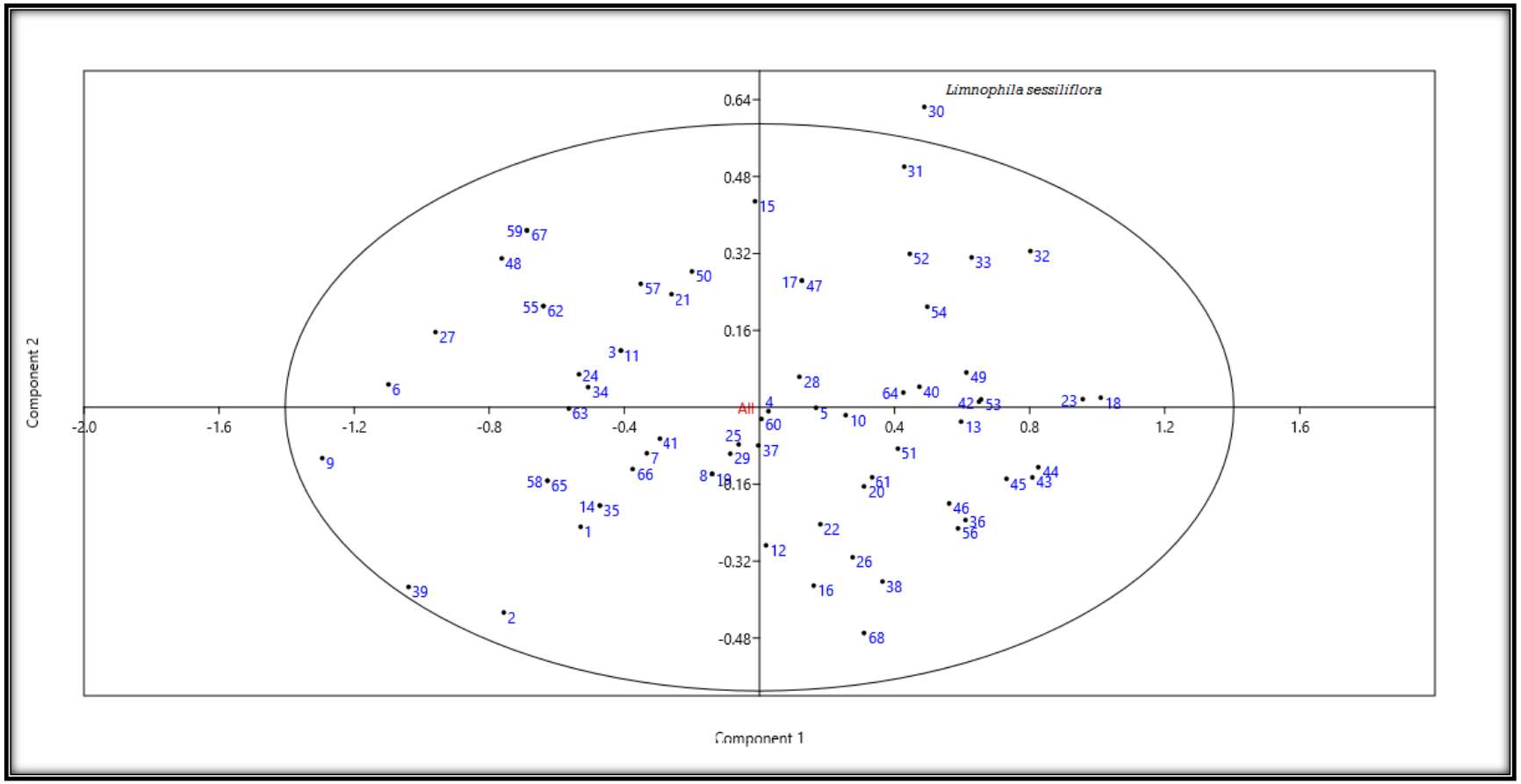


Figure 168: PC (Principal Component) analysis of Dicotyledons based on distribution with 95% ellipses:

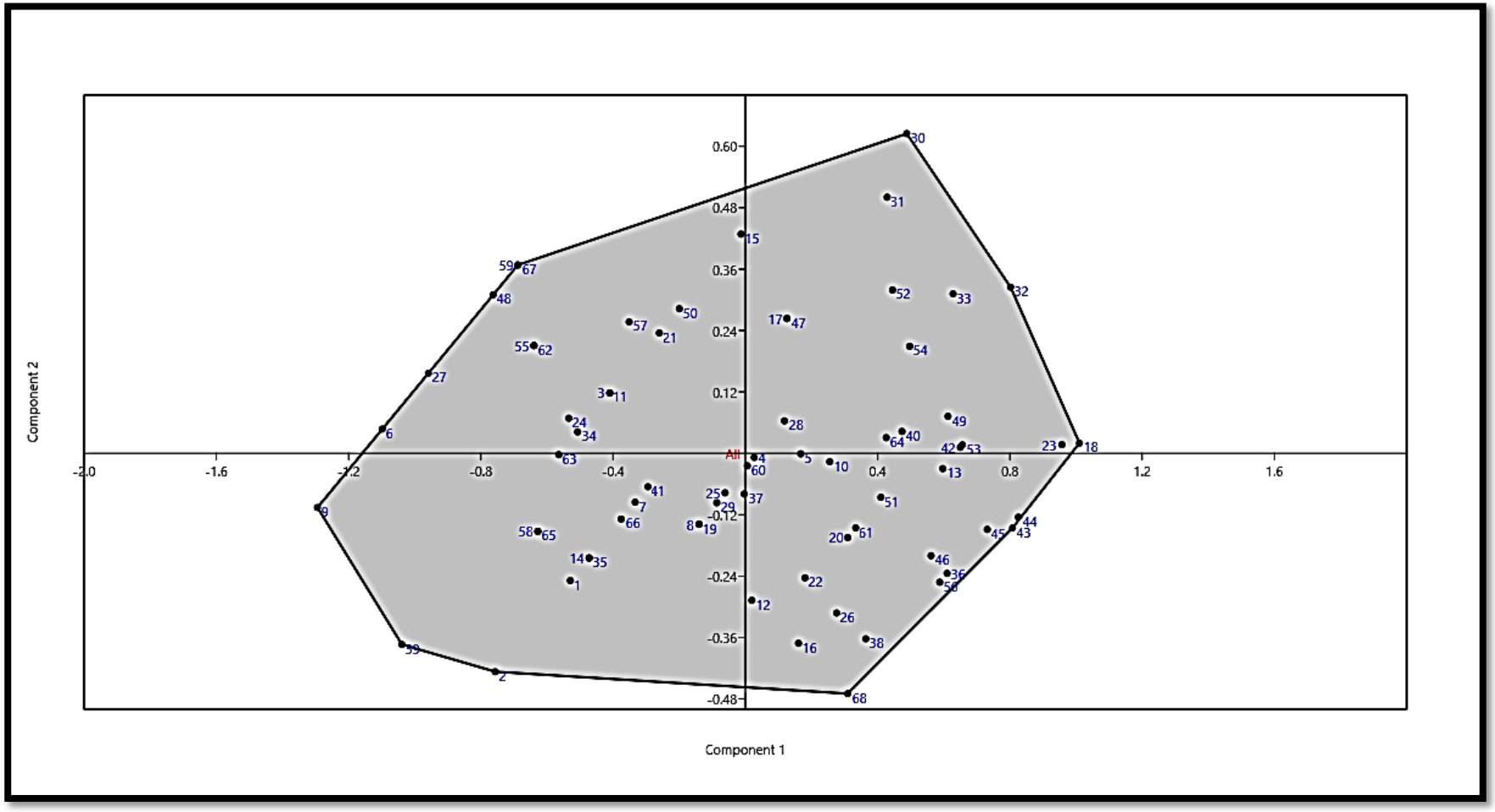


Figure 169: PC (Principal Component) analysis of Dicotyledons based on distribution with convex hulls:

7.8. Role of Aquatic and marshy land plant as a Home remedies and Ethnomedicine:

Aquatic plants have high-adapted features for their special environment. They draw their resources from their aquatic environment. Detailed medicinal uses of aquatic angiosperm documented from the various resource from persons, Ayurveda practitioners, and local ethnic people. The plant is deposited several compounds to their tissues which have the protective advantage to plants and these are also good medicinal values for the human being in cure different diseases. Plants are directly used as fodder and their different parts such as fruit, flowers, leaves, and root used as food. Also, use as home remedies. *Coix laceyma-jobi* utricles are used for decoration, medicine, and as food as flour or for beer. It is good fodder, leaf sometimes used for thatching. *Colocasia esculenta* cultivated for its starchy rhizomes and edible leaves or ornament. *Commelina benghalensis* used locally as a refrigerant for skin inflammations and as a cure for leprosy. *Commelina diffusa* bruised plant used locally against burns, itches, and boils. *Cyperus iria* fresh plant, particularly roots are aromatic and used as a medicine, and are also used for marketing mats. *Echinochloa crus-galli* is a good fodder before flowering. *Eichhornia crassipes* utilized as fodder, manure, and source of methane and alcohol, for purifying water, for decoration. *Monochoria hastata* leaf stalks are used as a vegetable, rootstock fed to livestock and in medicine, it used as a cooling agent. *Monochoria vaginalis* leaves and flowers are used as potherbs and medicine, the root is used for toothache. *Pistia stratiotes* use as antiseptic, anti-dysenteric, insecticide and cure for asthma. Poor people eat *Sagittaria sagittifolia* corms; they are also used in medicine as an antiseptic. *Typha elephantine* is used for mat and papermaking.

Xyris indica cure ringworm, itch, and leprosy. *Alternanthera philoxeroides* used as green manure; it is also used in medicine, sold in the market as a vegetable. *Hygrophila difformis* is a popular aquarium plant. *Hygrophila auriculata* has diuretic properties and used locally for

the disease of the urine-genital tract and dropsy. Seed sold commercially in the market. *Nelumbo nucifera* seeds for skin disease and diarrhea, rhizome for piles, and ringworms.

A total of 63 aquatic and marshy land plant species, belonging to 33 genera recorded from a preliminary survey of the district Paschim Medinipur. Plants used in the different diseases of the tribal peoples. Some of these important diseases are excessive thirst, diarrhea and fever, phlegmon, impetigo, mastitis, cystitis, eruptive fever, dysentery, burning sensation, hyperpiesia, epistaxis dyspepsia, vomiting, toothache; wounds, rheumatism, anorexia, flatulence, colic, helminthiasis, ulcers, asthma, bronchitis, knee joint pain, gonorrhea, indigestion, jaundice, abdominal disorders, cough, piles, malaria, wheezing, worms and sinusitis fever, liver disease, leprosy, psychopathy, ophthalmic, caries of teeth, chickenpox, children fever, constipation, hepatitis; dermatomycosis, tinea imbricate, scabies, eye disease; edema, gingivitis, and periodontosis, etc.

Figue 170. A: *Alpinia aquatica*, B, C: with fruits and rhizome

Figue 171. A: *Oryza rufipogon*, **B:** *Monochoria hastata*, **C:** *Neptunia oleracea*, D **:** *Nymphaea nouchali*

Figure 172. A: plant stem during the dry condition, **B:** plant stem bundle after collection, **C, D, E:** plant stem cutting during the decoration of handcraft, **F:** family members with surveyors during the field visit.

Figure 173: Some important medicinal plant **A:** *Grangea maderaspatana,* **B:** *Nymphoides indica,* **C:** *Hygroryza aristata*, **D:** *Enhydra fluctuans,* **E:** *Eclipta prostrate,* **F:** *Ludwigia adscendens,* **G:** *Monochoria vaginalis*, **H:** *Colocasia esculenta*, **I:** *Eichhornia crassipes,* **J:** *Heliotropium indicum,* **K:** *Bacopa monnieria,* **L:** *Nelumbo nucifera*.