Using Remote Sensing & Geographical Information System to Study the Changes in the Coastal area between Port Said and Manzala (1973-2004)

Tolba B. Abdel-Hady*

ABSTRACT

Landsat images at 1973, 1984, 1996, 2000, and 2004 of Port Said - Manzala areas were possessed. SRTM Digital train model was analyzed. Land cover /Lake Manzala areas changes in five different periods (1973-1984, 1984-1996, 1996-2000, 1996-2004, 1973-2004) were assessed. The visual image analysis proved that the Lake Manzala area's decrease to -28% through 1973 to 2004. The decrease was obvious in 1984 and 2000. The annual rate of change was -5% through 1996 to 2000 and -3% though 2000 to 2001. Sea shore change is evident throughout 1984 to 2004. Sea shore erosion and accretion are obvious to the northeast and northwest of study area at Damietta and Barr Ad-Dahrah and to the east of Port-Said city. Urbanization encroachment is evident. 53% of the Damietta to Port Said study area will be vulnerable to sea level rise of 1 m above the main sea level. Throughout 1973 to 2004 the Lake Manzala water area's decrease from 55 to 21%. The aquatic natural vegetation areas increase from 23 to 27%. Due to the draining/drying processes at south of Port Said the agriculture land areas and the terrestrial natural vegetation areas increase to 14.1 and 14.5% of the study area by September 2004, respectively. The bare land/ urban area increases to 20% by 2000 and the fish ponds areas account 10% of the study area by 2004. The magnitude of change in Lake Manzala water areas was -61% whereas the change in agricultural land areas was +420% from 1973 to 2004. The magnitude of change in aquatic natural vegetation and fish ponds areas was significant in 1984 and 2004. It is evident that an intensive eutrophication processes has been taken place in Lake Manzala through 1973 to 2004. The percentage of the Lake Manzala water area that transformed to aquatic natural vegetation increased to 19%, 33% by 1984 and 2004, respectively. [Bul. Soc. Géog. d’Égypte, 2020, 93: 115-130]

Key Words: RS, GIS, Change Detection, Damietta, Port Said, Lake Manzala.

1. Introduction

Due to draining/drying processes at the west of Lake Manzala south of Port Said in the context of El-Salam Mega project (MWRI, 1995), the Coastal Areas of Port Said – Manzala is faced with significant land covers change. In the context of establishment an environmental knowledge base for the area of Port Said (Tahoun and Barakat, 2006). The objectives of this study were to assess and evaluate the land and water resources of Port Said coastal area by integrating Remote Sensing (RS) and Geographic Information System (GIS) methodologies. Land cover dynamics and land suitability evaluation were considered (Abdel-Kader and Yacoub, 2008).

* Lecturer of Physical Geography, Faculty of Arts, Mansoura University; Egypt.

For Correspondence: e-mail: tolbaborham@mans.edu.eg
The objectives of this study are to assess the change detection of Port Said-Manzala area by integrating RS/GIS capabilities. MSS/LANDSAT Images for the date of 1973, 1984, 1996, 2000, and 2004 were considered.

2. Study Area

The main study area is located in the Port Said coastal zone between Damietta Branch and East Suez Canal. A sub area located in the Port Said coastal zone was considered according to the following boundaries: North: Mediterranean Sea, East: Suez Canal, South: El-Salam Canal and West: El-Salam Canal, Matarya town in the Manzala Lake (Figure 1).

![Figure 1. Location Map of Main and Sub study areas: Damietta to Port-Said.](image)

3. Materials and Software

3.1 Materials:
3.1.1 Satellite images of MSS (MultiSpectral Scanner) 1973, ETM (Enhancement Thematic Mapper) 1984, 1996, 2000, 2004.
3.1.2 Shuttle Radar Topographic Mission (SRTM) Path 176 and row 38 date 2001.

3.2 Software
ILWIS 3.3, Arc GIS 10.1, IDRISI Taiga 16 and ERDAS Imagine 9.1.
4. Methodology

4.1 Image Restoration:
- **Grounds Trusting:** During an initial field visit, field GPS controlled points were collected in order to re-examine the geo-referencing of the ETM 2004.
- **Geometric Restoration:** Resample module was used. Map projection and coordinate system of the ETM 2004 was considered to rectify all images using Image to Map and Image to Image techniques. UTM_Zone_36 N. and X, Y Resolution = 30 m. were considered.

4.2 Visual Interpretation:
Principal Compounded Analysis (PCA) was carried out to assign informative bands. False Color Composites were developed. Screen digitizing was carried out to assign Lake Manzala areas and sea shore lines. Google Earth image was considered to assign urban settlements.

4.3 Digital Image Processing:

4.3.1 Vegetation Indices: Normalized difference vegetation index (NDVI).

4.3.2 Unsupervised Classification: ISOCLUST in IDRISI was applied. ISOCLUST uses a procedure known as Selt-Organizing Cluster Analysis to classify up to 7 raw bands with the user specifying the number of clusters to process.

4.3.3 Land Cover Change Analysis:

4.3.3.1 Difference Image: Vegetation Index Images were considered. The difference image = later - earlier. Significant vegetation/Biomass change should be more than the Mean±Standard Deviation.

4.3.3.2 Percentage of Change: Land cover maps were considered. The percentage of change = (later-earlier) / earlier × 100.

5. Results and Discussion

5.1. Lake Manzala Area Change:
The visual image analysis proved that the Lake Manzala area's decrease to -28% through 1973 to 2004. The decrease was obvious in 1984 and 2000. The annual rate of change was -5% through 1996 to 2000 and -3% though 2000 to 2001. In general the decrease in Lake Manzala areas was more evident in the fall season versus the spring season dates. Table (1) shows the Lake Manzala areas change from 1973 to 2004. Table (2) shows the annual rate of change of Lake areas for fall and spring seasons.
Table 1. Lake Manzala area change (1973-2004).

| Date           | Area Acres | Change per 1973 Acres | Change % per 1973 | Change per Date Acres | Change % per Date |
|----------------|------------|-----------------------|-------------------|-----------------------|-------------------|
| January 1973   | 364594     |                       |                   |                       |                   |
| April 1984     | 302395     | -26199                | -17.06            | -62198                | -20.57            |
| September 1984 | 368597     | 4003                  | 1.10              | 66202                 | 17.96             |
| March 1996     | 299894     | -64700                | -17.75            | -68702                | -22.91            |
| September 1996 | 315904     | -48690                | -13.35            | 16009                 | 5.07              |
| September 2000 | 265139     | -99455                | -27.28            | -50765                | -19.15            |
| January 2001   | 263560     | -101034               | -27.71            | -1579                 | -0.60             |
| November 2001  | 264427     | -100167               | -27.47            | 867                   | 0.33              |
| April 2004     | 261370     | -103224               | -28.31            | -3056                 | -1.17             |
| September 2004 | 264946     | -99648                | -27.33            | 3575                  | 1.35              |

Table 2. Area change per season and annual rate of change of Lake Manzala for spring and fall (1973-2004).

| Date           | Change per Season Acres | Change % per Season | Annual Rate of Change % | Change per Season Acres | Change % per Season | Annual Rate of Change % |
|----------------|-------------------------|---------------------|-------------------------|-------------------------|---------------------|-------------------------|
|                | Spring                  | Fall                |                         |                         |                     |                         |
| January 1973   |                         |                     |                         |                         |                     |                         |
| April 1984     | -62198                  | -20.57              | -1.87                   |                         |                     |                         |
| September 1984 |                         |                     |                         |                         |                     |                         |
| March 1996     | -2500                   | -0.83               | -0.07                   |                         |                     |                         |
| September 1996 |                         |                     |                         |                         |                     |                         |
| September 2000 | -52692                  | -16.68              | -1.39                   |                         |                     |                         |
| January 2001   | -36334                  | -13.79              | -2.76                   |                         |                     |                         |
| November 2001  | -711                    | -0.27               | -0.13                   |                         |                     |                         |
| April 2004     | -2189                   | -0.84               | -0.21                   |                         |                     |                         |
| September 2004 | -192                    | -0.07               | -0.02                   |                         |                     |                         |

5.2. Sea Shore Change:

Sea shore change is evident throughout 1984 to 2004. Sea shore erosion and deposition are obvious to the north west of the study area at Barr Ad-Dahrah. It is of minor scale to the east Barr Ad-Dahrah; North of Port-Said city (Figure 2 and Table 3).
Figure 2. The Sea shore erosion and deposition of the study area at (a) Damietta area, (b) Barr Ad-Dahrah, and (c) East of Port-Said city.
Table 3. The Sea shore erosion and deposition of the study area at Damietta area, Barr Ad-Dahrah, and East of Port-Said city.

| Area (1984-2004)                      | Area in m² | Area in Acres | Changes in Acres |
|--------------------------------------|------------|---------------|------------------|
| Depositional area (Damietta Area)    | 2403601    | 593           |                  |
| Erosional areas (Damietta Area)      | 5646280    | 1396          | -800             |
| Depositional area (Port-Said Area)   | 1668475    | 412           |                  |
| Erosional area (Port-Said Area)      | 3470223    | 857           | -444             |
| Depositional area (Barr Ad-Dahrah Area) | 1557274  | 385           |                  |
| Erosional area (Barr Ad-Dahrah Area) | 2561870    | 632           | -247             |

5.3. Urban encroachment

Urbanization gross is evident in the study area. The urban areas comprised 2.3 to 4.2%. By 2004 The urban area of Port Said city increased by 3404 Acres, and the urban cities and rural residence areas comprised 11381 Acres (Tables 4 and 5).

Table 4. Annual and accumulative change in urban cities areas from Apr. 84 to Sep. 2004 in Acres.

| Date   | Port Said | El Matariyah | El Asafrah |
|--------|-----------|--------------|------------|
|        | Area Acres| Area Annual change | Area Accumulative Change | Area Acres | Area Annual change | Area Accumulative Change | Area Acres | Area Annual change | Area Accumulative Change |
| Apr-84 | 3912      |               |             | 111        |               |             |             |               |             |
| Sep-84 | 4174      | 262           | 262         | 516        | 52            | 52           | 133        | 22            | 22           |
| Mar-96 | 5661      | 1487          | 1749        | 647        | 79            | 131          | 135        | 2             | 24           |
| Sep-96 | 5888      | 227           | 1976        | 677        | 30            | 161          | 138        | 3             | 27           |
| Sep-00 | 6175      | 287           | 2263        | 682        | 5             | 166          | 138        | 0             | 27           |
| Jan-01 | 6222      | 47            | 2310        | 684        | 2             | 168          | 145        | 7             | 34           |
| Nov-01 | 6523      | 301           | 2611        | 699        | 15            | 183          | 145        | 0             | 34           |
| Apr-04 | 7043      | 520           | 3131        | 788        | 89            | 272          | 155        | 10            | 44           |
| Sep-04 | 7316      | 273           | 3404        | 798        | 10            | 282          | 158        | 3             | 47           |
Table 5. Areas of the urban cities and rural residence Sep. 2004 in Acres (Google Earth image visual interpretation).

| Type of Map                                      | Area Acres | Number | Acres  |
|-------------------------------------------------|------------|--------|--------|
| Urban cities & rural residence area (polygon)    | 153        | 10306  |
| Urban rural residence area (point)               | 2.47       | 193    | 476    |
| Urban rural residence area (point)               | 1.23       | 484    | 597    |

**Total area in acres** 11381

5.4. Digital Elevation Map:

The Shuttle Radar Topography Mission (SRTM) 2001 90 m. image of Port Said area p178r038 was downloaded. A sub seen equivalent to ETM+ sub scene 2004 was processed. The digital elevation–value map was worked out for the study area and a digital elevation model was generated (Figure 3). Different elevation classes were defined after using the histogram and slicing operations (Table 6). 26% of the area is under sea level. 27% is up to 1 m ASL where 43% is 1-5 m ASL.

![Figure 3. Digital elevation model classes of Damietta-Port Said study area.](image-url)
Table 6. SRTM classes of the Damietta-Port Said study area.

| Class range above sea level | SRTM Port-Said Acres | Area % | SRTM Port-Said + 1 meter increased of sea water Acres | Area % |
|-----------------------------|-----------------------|--------|-----------------------------------------------------|--------|
| (1) Less than 0             | 199824                | 25.98  | 408769                                              | 53.15  |
| (2) 0 - 1                   | 208944                | 27.17  | 193940                                              | 25.22  |
| (3) 1 - 5                   | 329826                | 42.89  | 140953                                              | 18.33  |
| (4) 5 - 10                  | 16724                 | 2.17   | 13519                                               | 1.76   |
| (5) More than 10            | 13721                 | 1.78   | 11858                                               | 1.54   |
| Total                       | 769039                | 100.00 | 769039                                              | 100.00 |

Digital Elevation Model (DEM) was edited to simulate sea level rise. Up to 53% of the Damietta-Port Said study area will be vulnerable to sea level rise of 1m above the sea level (reference Data, DEM _ SRTM 2002). In an attempt to comate the processes of erosion along the beach as well as the vulnerability to sea level rise, a sand replenishment program should be undertaken. A program that trucks sand from nearby deposits at North Sinai and dumps it in particularly vulnerable locations along the beach is of high priority. The main strategy is to widen the beach and rebuild/strengthen dune systems in front of developed areas. It is thought that reestablishing "natural" systems will be more effective and less expensive than other forms of coastal protection.

5.5. Land Cover of Port Said Area

5.5.1 Biomass:

A significant biomass cover changes has been occurred through 1973 to 2004. The Normalized difference vegetation index (NDVI) analyses indicted that the biomass has significantly increased (Mean±SD) through Jan-1973 to Apr-2004 at 7.58% of the study area.

5.5.2 Areas and Percentages of Land Cover Types:

Throughout 1973 to 2004 the Lake Manzala water area decreases from 55 to 21%. The aquatic natural vegetation areas increase from 23 to 27%. Due to the draining/drying processes south of Port Said the agriculture land areas and the terrestrial natural vegetation areas increase to 14.1 and 14.5% by September 2004, respectively The bare Land/Urban area increases to 20% by 2000 and the fish ponds areas account 10% of the study area by 2004 (Table 6 and Figure 4).
Table 6. Areas and percentages of land cover types of Port Said area.

| Legend                           | Jan_73 Acres | Jan-73% | Sep_84 Acres | Sep-84% | Sep_96 Acres | Sep-96% | Sep00 Acres | Sep-00 % | Sep_04 Acres | Sep-04 % |
|----------------------------------|--------------|---------|--------------|---------|--------------|---------|-------------|----------|--------------|----------|
| Water                            | 130619       | 55.46   | 91115        | 38.68   | 88921        | 37.75   | 62681       | 26.61    | 50270        | 21.34    |
| Aquatic natural vegetation       | 54672        | 23.21   | 68694        | 29.17   | 53015        | 22.51   | 52410       | 22.25    | 64561        | 27.41    |
| Terrestrial natural vegetation   | 7946         | 3.37    | 17965        | 7.63    | 28198        | 11.97   | 34406       | 14.61    | 34074        | 14.47    |
| Agriculture Land                 | 6404         | 2.72    | 5989         | 2.54    | 14114        | 5.99    | 17439       | 7.40     | 33284        | 14.13    |
| Fish Ponds                       |              |         | 29151        | 12.38   | 22220        | 9.43    | 20795       | 8.83     | 24197        | 10.27    |
| Bare Land/ Urban                 | 35895        | 15.24   | 22621        | 9.60    | 29067        | 12.34   | 47804       | 20.30    | 29149        | 12.38    |
| **TOTAL**                        | **235536**   | **100** | **235536**   | **100** | **235536**   | **100** | **235536**  | **100**  | **235536**   | **100**  |
Figure 4. ISOCCLUST land covers maps for Jan-1973 and Sep-2004.
5.5.3 Magnitude of Land Covers Change (1973-2004).
Temporal-spatial land covers change percentages from Apr 1984 to Sep 2004 was assessed Lake water areas decreased by 61% whereas agricultural land increased by 420% from 1973 to 2004. The magnitude of aquatic natural vegetation and fish ponds areas were significant in 1984 and 2004 (Figure 5 and Table 7).

Table 7. Magnitude of Land Covers Change (1973-2004).

| Legend                        | Change 73-84% | Change 84-96% | Change 96-00% | Change 00-04% | Change 73-04% |
|-------------------------------|---------------|---------------|---------------|---------------|---------------|
| Water                         | -30.24        | -2.41         | -29.51        | -19.80        | -61.51        |
| Aquatic natural vegetation    | 25.65         | -22.82        | -1.14         | 23.18         | 18.08         |
| Terrestrial natural vegetation| 126.08        | 56.96         | 22.01         | -00.97        | 328.81        |
| Agriculture Land              | -6.48         | 135.65        | 23.55         | 90.86         | 419.71        |
| Fish Ponds                    | 100.00        | -23.78        | -6.41         | 16.36         | 100.00        |
| Bare Land/ Urban              | -36.99        | 28.49         | 64.46         | -39.02        | -18.80        |

Figure 5. Gains and losses in land cover area in Acres between 1973 and 2004.

5.5.3. Nature and Location of Change in Lake Manzala Water Cover:
Figures (6) and Table (8) give spatial and types of Lake Manzala water cover change (1973-2004). It is evident that an intensive eutrophication processes has been taken place in Lake Manzala through 1973 to 2004. The percentage of the water area transformed to aquatic natural vegetation increased to 19 and to 33% by 1984 and 2004 respectively (Figure 7). The rate of eutrophication processes was 0.94%
aquatic natural vegetation area per year throughout 1973 to 1996 that increased to 1.41% per year throughout 1996 to 2004. On the other hand, 8.6% of the water area has been transformed to agricultural land and 8.3% to bare/urban areas by 2004. By 1984 11.8% of the water area has been transformed to fish ponds that decreased to 6.8% by 2004.

Figure 6. Spatial change of Lake Manzala Water 1973 to 2004.
Table 8. Types of Lake Manzala water cover change (1973-2004).

| Legend                    | Water_all 73-84 Acres | Water_all 73-84 % | Water_all 73-96 Acres | Water_all 73-96 % | Water_all 73-00 Acres | Water_all 73-00 % | Water_all 73-04 Acres | Water_all 73-04 % |
|---------------------------|-----------------------|-------------------|-----------------------|-------------------|-----------------------|-------------------|-----------------------|-------------------|
| Water to Aquatic Vegetation | 25343                | 19.40             | 28240                 | 21.62             | 37372                 | 28.61             | 43013                 | 32.93             |
| Water to Terrestrial Vegetation | 4493                | 3.44              | 8137                  | 6.23              | 10641                 | 8.15              | 11214                 | 8.59              |
| Water to Agriculture Land  | 735                  | 0.56              | 3088                  | 2.36              | 4991                  | 3.82              | 11260                 | 8.62              |
| Water to Fish Ponds       | 15421                | 11.81             | 10292                 | 7.88              | 7226                  | 5.53              | 8855                  | 6.78              |
| Water to Bare Land/ Urban | 4263                 | 3.26              | 7128                  | 5.46              | 19230                 | 14.72             | 10845                 | 8.30              |
| **Subtotal**              | **50257**            | **38.48**         | **56888**             | **43.55**         | **79462**             | **60.83**         | **85189**             | **65.22**         |
| **Persisted**             | **80361**            | **61.52**         | **73731**             | **56.45**         | **51157**             | **39.17**         | **45429**             | **34.78**         |
| **Total**                 | **180873**           | **100**           | **180873**            | **100**           | **180873**            | **100**           | **180873**            | **100**           |
Conclusion

The objectives of this study are to assess land covers change of Port Said area by integrating Remote Sensing (RS) and Geographic Information System (GIS) methodologies. MSS and Enhanced LANDSAT Images for different dates were used. Digital elevation model as well as sea shore change for 1984-2004 was worked out. Vegetation cover and unsupervised image classification layers were processed. The changes in land cover and Lake Manzala areas in five different periods (1973-1984, 1984-1996, 1996-2000, 1996-2004, 1973-2004) were assessed. The results indicated that:

1. The Lake Manzala areas decrease to -28% through 1973 to 2004. The decrease was obvious in 1984 and 2000. The annual rate of change was -5% through 1996 to 2000 and -3% through 2000 to 2001. In general the decrease in Lake Manzala areas was more evident in the fall season versus the spring season.

2. Sea shore change is evident throughout 1973 to 2004. Sea shore erosion and deposition are obvious to the north west of the study area at Damietta, Barr Ad-Dahrah, and east Port-Said city.

3. Urbanization encroachment is evident in the study area. By 2004 the urban area of Port Said city increased by 3404 Acres, and the urban cities and rural residence areas comprised 11381 Acres.

4. Digital Elevation Model proved that 53% of the Damietta Port Said study area will be vulnerable to sea level rise of 1m above the 2002 sea level. A sand replenishment program should be undertaken. A program that trucks sand from nearby deposits at North Sinai and dumps it in particularly vulnerable locations along the beach is crucial.

5. Throughout 1973 to 2004, the Lake Manzala water area decreases from 55 to 21%. The aquatic natural vegetation areas increase from 23 to 27%. Due to the draining/drying processes south of Port Said the agriculture land areas and the terrestrial natural vegetation areas increase to 14.1 and 14.5% by September 2004, respectively. The Bare Land/Urban area increases to 20% by 2000 and the fish ponds areas account 10% of the study area by 2004.

6. The magnitude of change in Lake Manzala water areas was -61% whereas in agricultural land areas was +420% from 1973 to 2004. The magnitude of change in aquatic natural vegetation and fish ponds areas were significant in 1984 and 2004.

7. It is evident that intensive eutrophication processes has been taken place in Lake Manzala through 1973 to 2004. The percentage of the Lake Manzala water area that transformed to aquatic natural vegetation increased to 19% and to 33% by 1984 and 2004 respectively. The rate of eutrophication processes was 0.94% aquatic natural vegetation area per year throughout 1973 to 1996 that increased to 1.41% per year.
The Changes in the Coastal Area between Port Said and Manzala

throughout 1996 to 2004. On the other hand, 8.6% of the water area has been transformed to agricultural land and 8.3% to bare/urban areas by 2004. By 1984, 11.8% of the water area has been transformed to fish ponds that decreased to 6.8% by 2004.

References
1. Abdel-Kader, F.H. and R.K. Yacoub (2008): The Execution of Specific Assessments in the Coastal Areas of Port Said: Land Resources. Final Report. February 2008. Action Program (SMAP) “Plan of Action for an Integrated Coastal Zone Management in the area of Port Said (Egypt)” ACTION5. www.iczmportsaid.com/Intersectoral Analysis/Land. PDF
2. Clark Labs (2006): IDRISI Tiaga 16. User’s Guide, Clark University. Worecester, MA, USA
3. ERDAS, Inc., (2003): ERDAS Imagine version 9.1, Field Guide, Fourth Edition ERDAS, Inc., Atlanta, Georgia. USA.
4. ESRI. (2004): ArcGIS software. Environmental Systems Research Institute, Inv. Redlands, CA. Sensing 23:1741-1748.
5. ILWIS 3.3, (2003): “The integrated land and watershed management system (ILWIS): User’s Guide”, ITC, Enschede, The Netherlands.
6. Jackson, M.L. (1967): “Soil Chemical Analysis”, Prentice Hall of India Private Ltd., New Delhi.
7. MWRI (1995): Ministry of Water Resources and Irrigation, Egypt. www.nwrc-egypt.org
8. Tahoun, S.A and E. Barakat (2006): Integrated Coastal Zone Management in The Area of Port Said, Egypt. SMAP III TA, ICZM Regional Kick off Workshop Cairo Egypt, February 22-23, 2006. Cairo, Hotel Marriot
استخدام الاستشعار عن بعد ونظم المعلومات الجغرافية في دراسة التغيرات بالمنطقة الساحلية الممتدة بين بورسعيد والمنزلة (1973-2004)

الملخص

تتناول هذه الدراسة رصد وكشف التغيرات في منطقة بورسعيد – المنزلة، وذلك من خلال استخدام تقنيات الاستشعار عن بعد ونظم المعلومات الجغرافية، وقد تم استخدام مرئيات الأقمار الاصطناعية لأعوام 1973، 1984، 1996، 2000، 2004.

وأثبت تحليل المرئيات الفضائية إلى انخفاض مساحة منطقة بحيرة المنزلة إلى 38% خلال الفترة (1973-2004) وكان هذا الانخفاض واضحًا في عامي 1984، 2000، وبلغ معدل التغير السنوي -5% خلال الفترة (1996-2000)، و-3% من (2002-2004). كما تعرضت منطقة خط الشاطئ للتغير خلال الفترة (1984-2004) بسبب عمليات النحت والإنساب خاصة شمال شرق وشمال غرب منطقة الدراسة في دمياط وشرقي الشرق من مدينة بورسعيد.

كما أثبتت الدراسة أن حوالي 53% من منطقة الدراسة بدمياط وبوسعيده سيكون عرضة للغرق جراء ارتفاع منسوب سطح البحر إذا ارتفع بمقدار متراً واحدًا. وقد تعرض المسطح المائي لبحيرة المنزلة لانخفاض من 55 إلى 21% خلال الفترة (1973-2004) في مقابل ذلك زيادة في مساحة مناطق النباتات الطبيعية المائية من 27% خلال نفس الفترة. ونظراً لعمليات التجفيف جنوب بورسعيد، فإن مساحة الأرض الزراعية ومناطق الغطاء النباتي الطبيعي قد تعرضت للزيادة من 14.1% إلى 44.5% عام 2004.

وفي الملحصة فقد بلغ مقدار التغير في مساحة المسطح المائي لبحيرة –11%، في حين كان التغير في مساحة المناطق الزراعية +20% خلال الفترة (1973-2004).