



GIS For Petroleum in the Curriculum of Geography: Case of UAE University

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Overview

- **Objectives of the paper**
- **GIS application for petroleum**
- **GIS for petroleum course**
- **Problems and ways around**
- **Recommendations**
- **Conclusion**

Objectives of the paper

- Address issues related to the introduction of GIS for Petroleum course in the Geography curriculum.
- Provides a UAE perspective on teaching GIS for Petroleum course and share experience with other Universities.
- Explore suitable model for teaching GIS for Petroleum course.

GIS application for petroleum

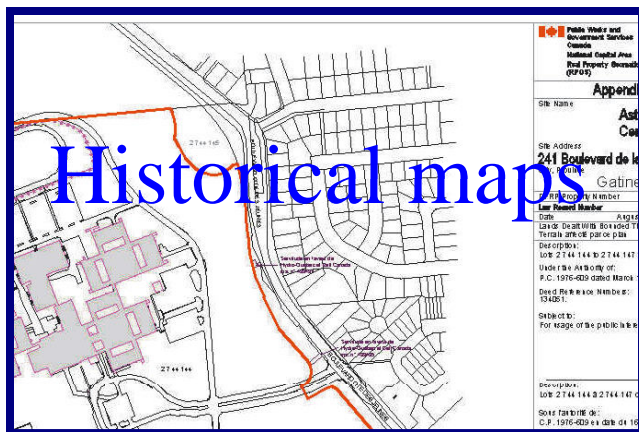
- Petroleum professionals involved in upstream, midstream, and downstream activities can use GIS, tabular data sets, GPS, aerial photographs, remote sensing, and other real-time and historical information.
- **Exploration:** Generation of probability maps
- **Production :** Managing/monitoring/AM/FM
- **Marketing :** Pipelines, networks, service areas. Turn raw data into information, information into knowledge, and finally knowledge into decision.
- GIS enables Petroleum teams to share information, analyze data in new ways, and integrate the evaluation process.
- **GIS saves time and money**

Integration of diverse data for petroleum operations

Satellite images



Statistics



Video

Photo

GIS for petroleum course

- To develop an understanding of the applications of GIS in the petroleum industry.
- To expose the students to the applications of remote sensing and GPS in the petroleum operations.
- To review GIS models and spatial analysis related to the application of GIS in the petroleum field.

Course outcomes

- Integrate different GIS data to solve real petroleum problem (well site selection, pipe line siting, corridor selection, marketing, and environment).
- Evaluate and critically identify the strength, weakness, and constraints of applying remote sensing, GPS, and GIS in the petroleum industry.
- Demonstrate ability in using GIS software to build petroleum database, perform spatial analysis, prepare maps, reports, and charts for presentation of results.

Week	Topic
1	Course outline and Introduction to GIS for Petroleum
2	Quick revision to GIS and Remote Sensing
3	Application of Remote Sensing for oil exploration and oil spill
4	Use of GIS Spatial Analysis for well Site selection
5	GIS Spatial Analysis for optimum pipeline network determination
6	Application of GPS in the petroleum industry
7	GIS for Petroleum marketing (supply-demand)-Network analysis
8	Visit to governmental/private departments implementing GIS for Petroleum
9	GIS as database management systems for the petroleum industry Integration of heterogeneous data and different software
10	Generation of 3D and sub-surface models to aid in petroleum exploration, management, and monitoring. Visualization, fly-over, animation
11	Global Mapping of oil
12	Web-based GIS and Mobile Mapping for the petroleum industry
13	Presentation of GIS For Petroleum projects

Visit to governmental/private departments implementing GIS for Petroleum

- Abu Dhabi Company for Onshore oil operations (ADCO).
- The students and the faculty get to know about the daily operations of the company and how GIS, surveying engineering, GPS, and remote sensing are integrated for providing permissions for oil exploration companies, coordinating between various utilities departments, and managing the petroleum assets.
- GIS employers delivered talks on their experiences with GIS implementation in petroleum followed by live demonstration on GIS systems and open discussion with students.

The practical part of the course

- Provide students with hands/training on remote sensing and GIS software and at the same time satisfy the 3R (Researched, Relevant, Reactive) approach.
- Researched focus on setting the objective of the training, relevant means using data that is familiar to the trainees (UAE data), and Reactive ensures that expectations can be satisfied without isolating either fast or slow learners.

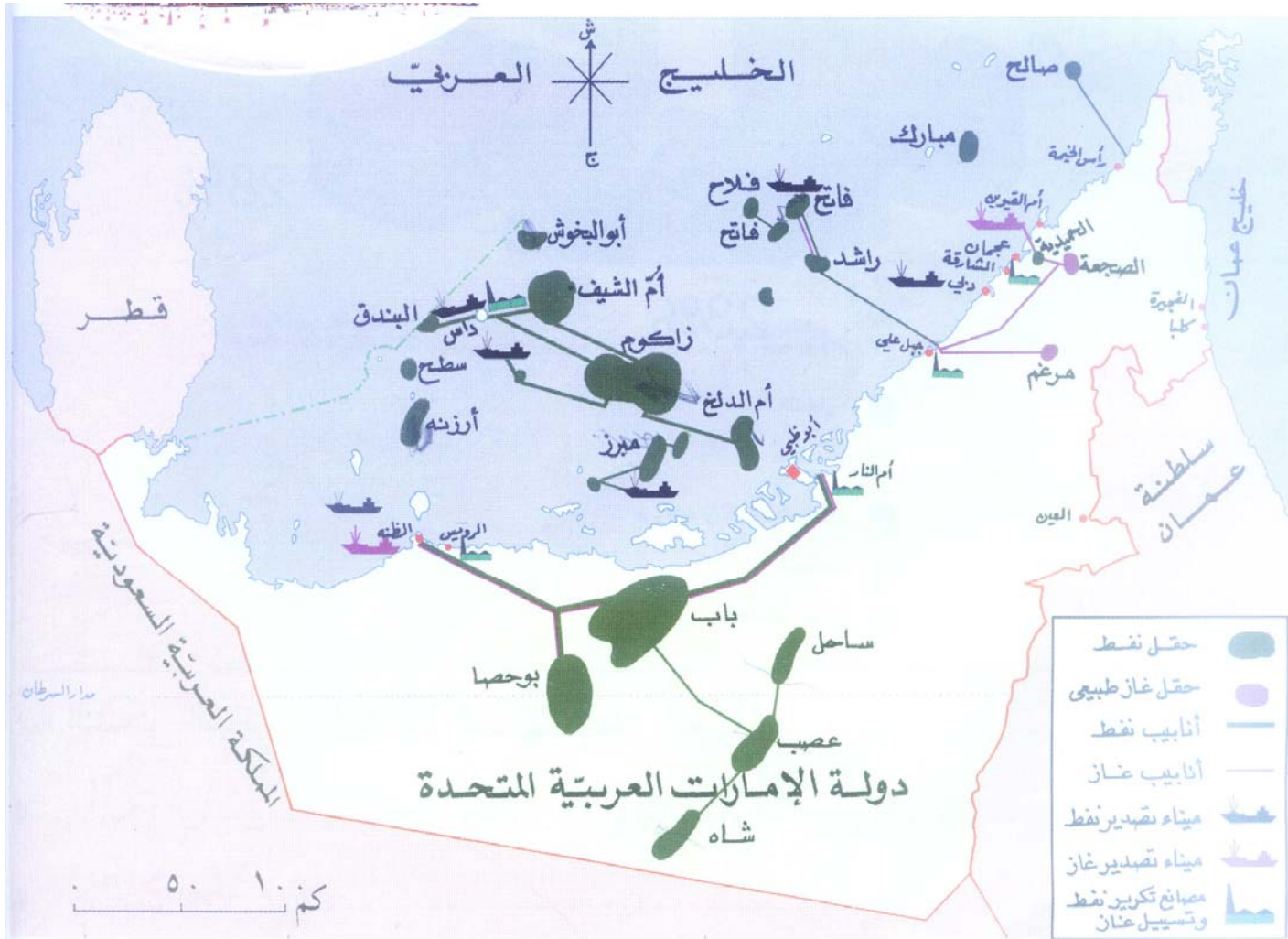
Example of students' projects

- Analysis using critical thinking to detect any clues for the relationship between the geological formation, land use type and areas of high **oil reserved**
- Generate 3-D model (contour-DEM) and overlay with the satellite image and check if there is any relationship between elevation/slope and oil availability
- Overlay the **pipelines** on the 3D model and satellite image and check whether the route through which the pipelines network passes is economically feasible (slope, cut, fill, soil stability) and environmentally sound (does it passes near or through population centers, agricultural land, valleys, habitat reserved, etc.)
- Does **pollution** status near oil fields and refineries affect/endoranger air, water, land, and human health?

Example: Global status of petroleum

- Data: World map, world satellite image, countries with high production, countries with high consumption
- Analysis: Flow maps showing import and export of oil and gas routes, factors affecting on marketing (distance, quality of oil)
- Calculate the distance and find estimate for transportation (cost of \$/tonne/per km) and the effect of means of transportation (pipeline, ships, rails, etc.)
- Investigate the relationship between oil consumption, population density, and economy
- World conflict areas and their impact on oil prices

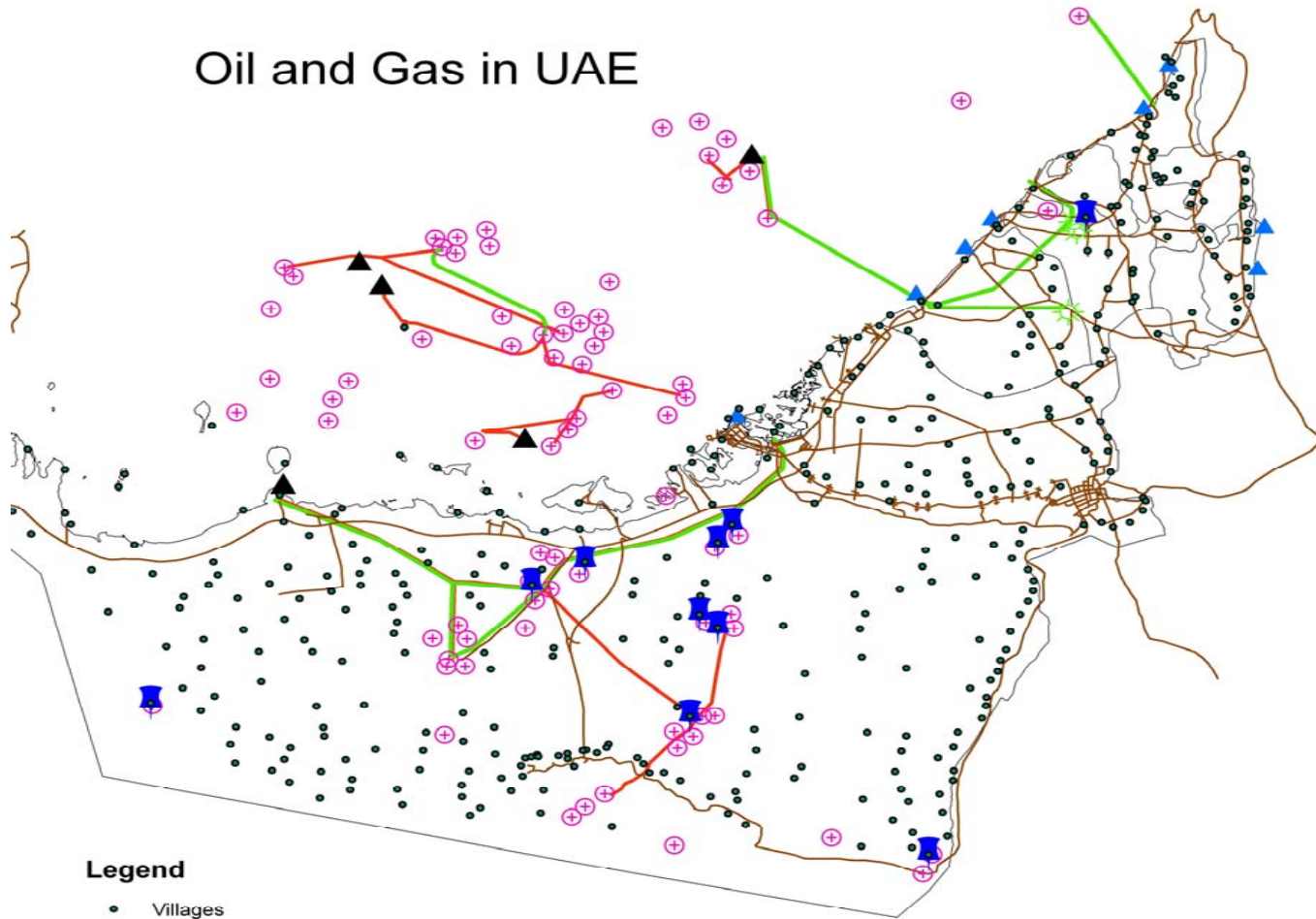
Oil and gas in UAE



حقول وأنابيب النفط بدولة الإمارات العربية المتحدة

Source: UAE grade 4 Social Studies Textbook, 2008

Oil and Gas in UAE



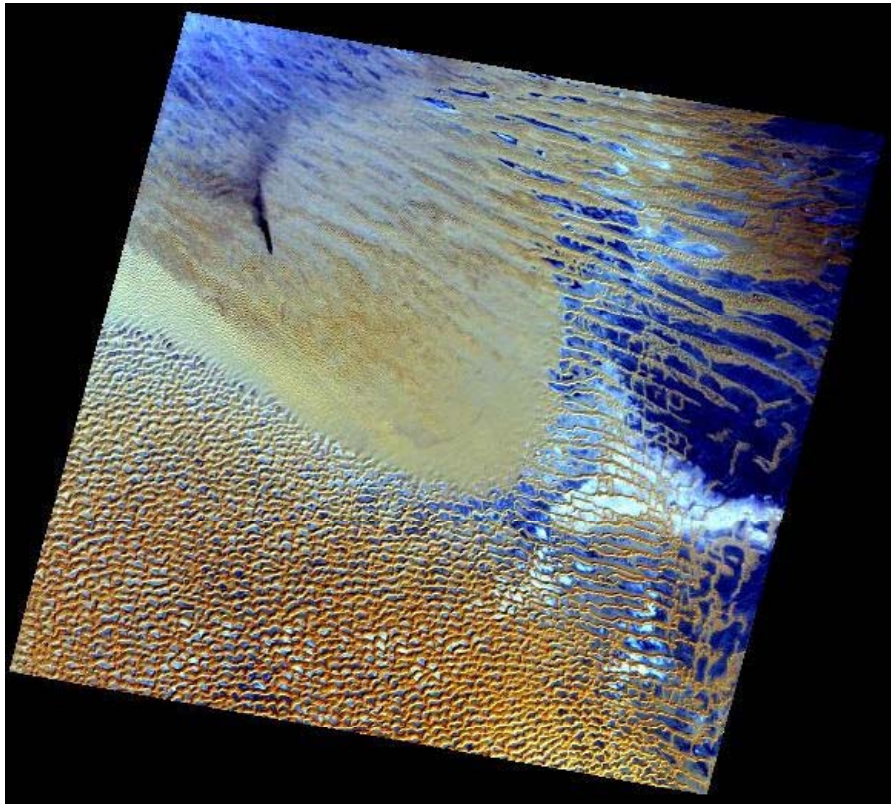
Legend

- Villages
 - 📌 Villages within 6 km from Oil Fields
 - ▲ Ports
 - ▲ Oil Terminal
- ### Oil and Gas Fields
- ☀ Gas Field
 - ⊕ Oil Field
- Roads
- ### Pipelines
- Gas Pipeline
 - Oil Pipeline
 - UAE Boundary

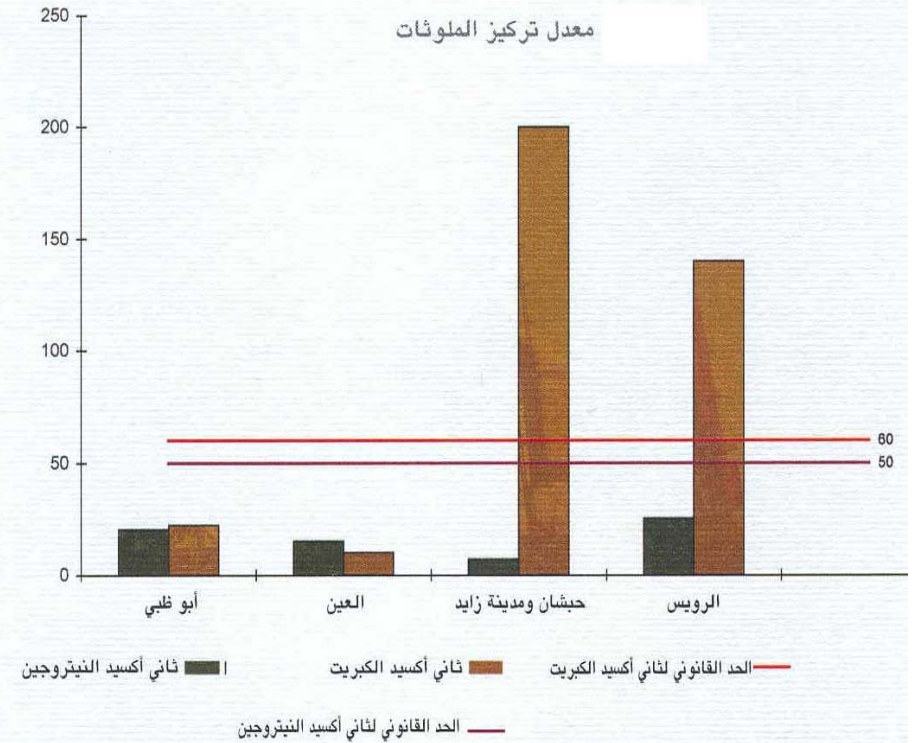


Integration of diverse data to study impact of oil on population centers

Integration of remote sensing and statistical data to understand Air pollution in UAE



**West Abu Dhabi- Liwa:
Landsat Image:29-11-1972**



**West Abu Dhabi- Liwa:
High Carbon Dioxide
EAD: 2005**

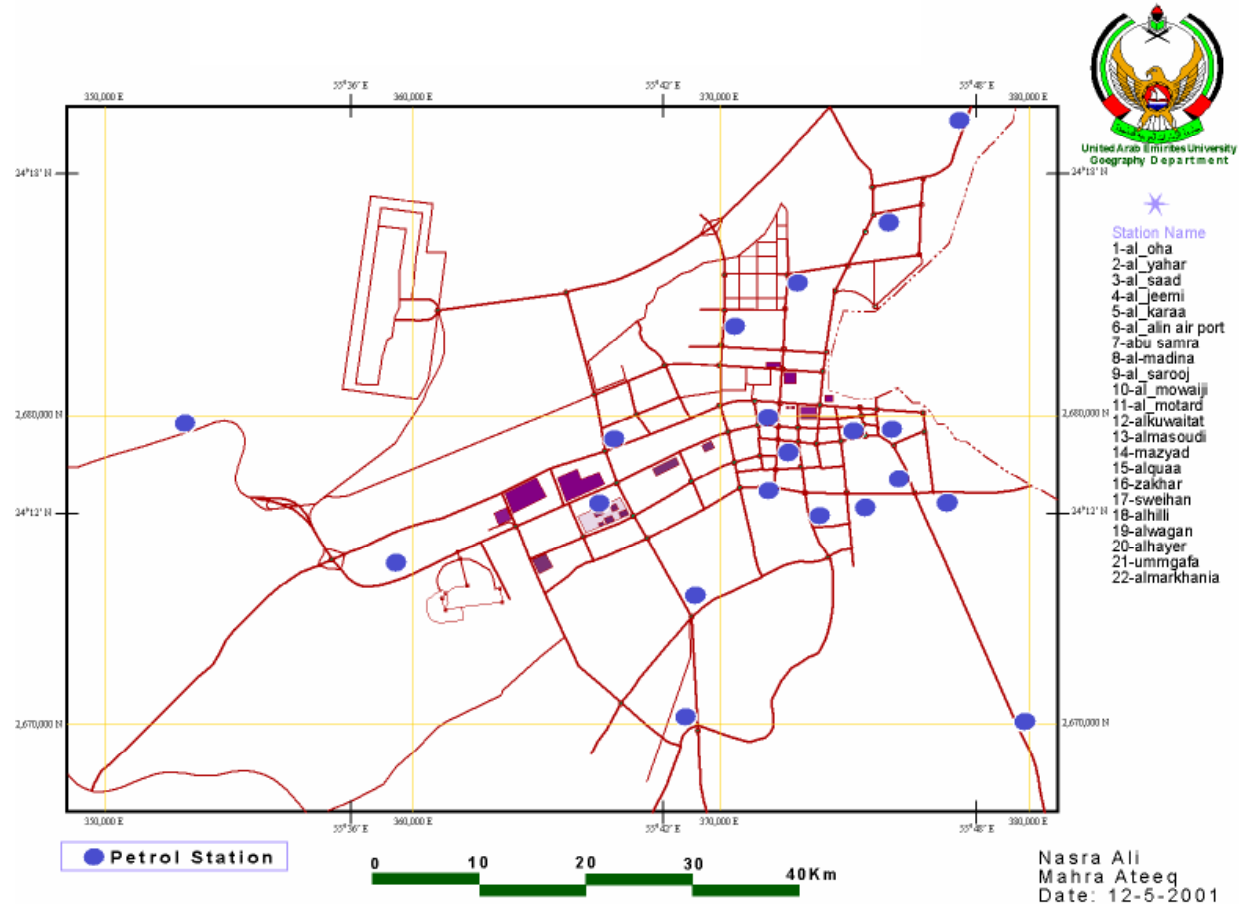
Example: **Analysis** of Petrol stations in Al Ain

- Check if there is any correlation between the increase in the number of stations with increase in population and cars (use the time series analysis)
- Calculate the distances between stations and check the distribution pattern, relationship between distribution of stations and population and car density and traffic volume in each road,
- Calculate the distances between stations and civil defense centers?
- Identify stations that are close to highly concentrated-population centers, estimate the number of people who will be affected in case of fire hazards-vicinity-vulnerability (use different scenarios with different buffers), other analysis...use your imagination....

Database about petrol stations in AL-Ain

station NO	station name	location	phone NO
1	ALMARKHANIA	AL MARKHANIYA AREA	7611898
2	SAIH BIN AMR	ABUDHABI ALAIN ROAD	7678986
3	UMM GAFA	AL DAHIR AREA	7821242
4	ALHAYER	AL HAYER SWAIHAN ROAD	7321643
5	H.D TRUCK	ALAIN MUSAFAH ROAD	7838426
6	ALWAGAN	AL WAGAN VILLAGE	7351263
7	ALHLLI	AL HILLY AREA	7846595
8	SWEIHAN	SWAIHAN VILLAGE	7347020
9	ZAKHAR	NEAR ZAKHER ROUND ABOUT	7828198
10	ALQUAA	AL QUAA AREA	7356261
11	MAZYAD	NEAR POLICE CHECK POST	7821025
12	ALMASOUDI	IN FRONT OF ALMASOODI CLINIC	7637998
13	IND.AREA	SANAYIYYA AREA	7214578
14	ALKUWAITAT	NEAR TOWN POLICE STATION	7667901
15	ALMOTARD	IN FRONT OF JUMA MOSQUE	7655209
16	ALMOWAJI	JABAL ROUND ABOUT	7654020
17	ALSAROOJ	HILTON ROAD	7661195
18	ALMADINA	MAIN STREET	7654952
19	KHETEM ELSHOKIA	AL AIN - SOHAR ROAD	7687071
20	ABU SAMRA	AL ALIN ABU DHABI ROAD	7372390
21	ALMAQAM	AL MAQAM AREA (Alain-Abudhabi Road)	7682472
22	AIAIN AIRPORT	INSID AL AIN AIRPORT	7855106
23	ALKARAA	DUBAI-ALAIN AIRPORT	7322485
24	AL FAQAA	AL FAQAA AREA	7331292
25	AL JEEMI	KHABEESI AREA	7631305
26	AL SHOWAIB	SHAWABI VILLAGE	7323424
27	SHABHAATH	SHABHATH AREA	7686956
28	ALSAAD	ABU DHABI ALAIN ROAD	7827015
29	AL YAHAR	YAHAR AREA (Alain-Abudhabi Road)	7826571
30	ALGAHIL	MANASIR ARER	7663947
31	AL OHA	NEAR AL OHA ROUND ABOUT	7832019
32	BATHA AIHAYEER	(BATHA AL HAYER (Sanayiyya	7210402

Petrol stations in Al Ain



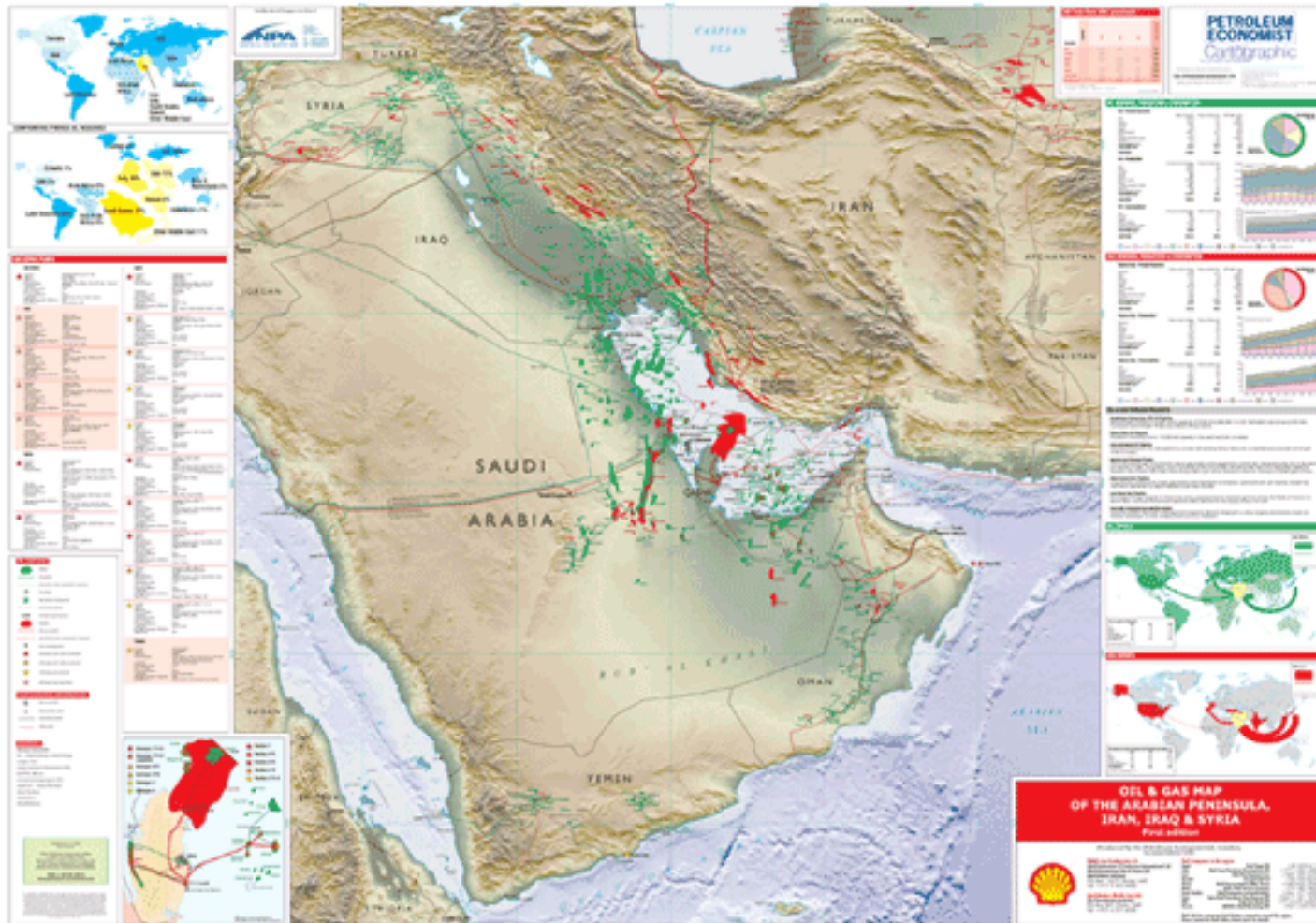
Benefits from students' projects

- Students had proved their capabilities to carry out GIS projects starting from field survey to presentation (*outcome*). Results of the projects are presented in a form of models, maps, reports, charts and a database with a custom interface
- Team work
- The lesson learned from these projects is that students are able to convince their families to participate in collecting of field data. This has a positive advantage that families (community) are becoming part of the educational process

Problems and ways around

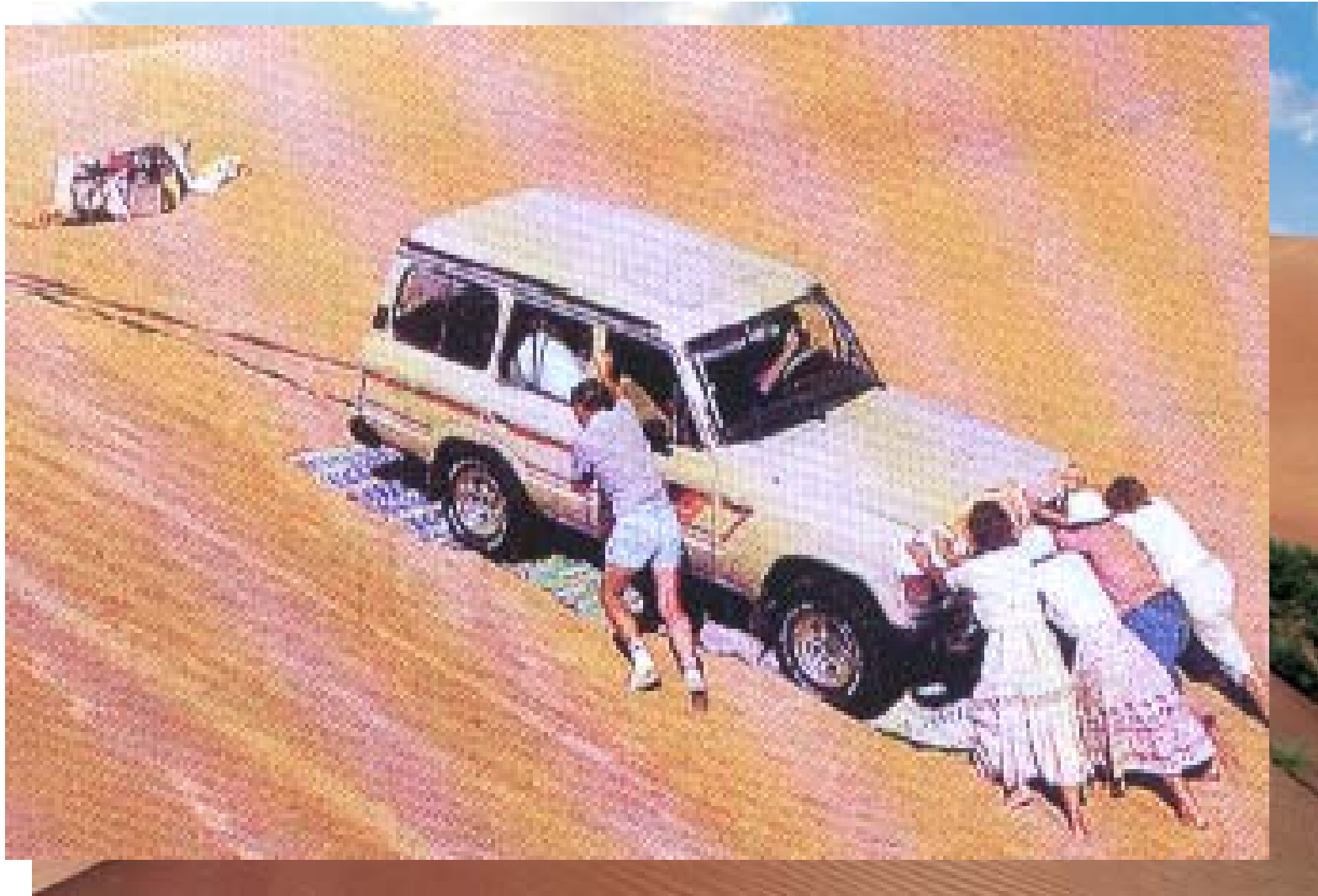
- A suitable textbook (There is no shirt fits all sizes)
- Heterogeneity of students register for the course (Geography, Engineering, Geology, Urban)
- Language constraint (Visual aids such as photos, illustrations, charts, graphs, and maps provide context that helps students understand the linguistic/conceptual input)
- Difficulty in obtaining local petroleum data (security issue, data limits the range of research questions, problem-based, and applications to which students are exposed. Therefore, data from other parts of the world is utilized)
- The need for specialized GIS and subsurface 3D software (e.g. Environmental Visualization System from C Tech, budget, use ArcView 3D extension, credit ESRI-GISTEC)
- Harshness of the petroleum environment (sand dunes, offshore , 70% of the students are females, prepare a suitable working environment for females)

Data for sale: Oil and Gas in the Arabian Peninsular



Source: Research and Markets-Energy Maps: <http://www.researchandmarkets.com/>

Harshness of the petroleum environment: Sand dunes, offshore, Hydrogen Sulfide (H₂S)



Recommendations

- Inclusion of a course dealing with surveying engineering and GPS
- Mathematics and computer science should be integrated with university-based courses (market demands).
- Inclusion of DBMS and AutoCAD as part of the GIS Lab.
- The current program's structure requires 132 credit hours for graduation with only 39 of them (30%) allocated for geography courses. it is recommended to allocate more credit hours to the specialty.
- Running "English plus content" courses and encourage more English-medium extra-curricular activities and societies.
- It is necessary to provide some sort of monthly meetings that allow undergraduate and graduate students and faculty to mingle to encourage pedagogy and research.

Conclusion

- The course provides students with a blend of theoretical and practical background about the use of geo-spatial techniques in the petroleum operations.
- Key learning objectives such as critical thinking, self-learning, creativity, analysis, and developing IT skills are incorporated in the body of the course.
- Teaching in English (second language for students) can be made more easier through extensive illustrations (maps, figures, satellite images, equations, numeric example, video clips) "*One image expresses thousands of words*".
- Teaching any GIS course requires human resources, interactive students (brain-ware), hardware, software, references, internet, and data.
- Students who studied the course have great hopes that they will find opportunities that match their GIS skills.

Thanks