

RGS-IBG Field Research Programmes

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● JORDAN BADIA RESEARCH AND DEVELOPMENT PROGRAMME

A joint UK-Jordanian research programme to provide decision makers, in both national government and local households, with the information they require for sustainable management of Jordan's Badia region.

Organised by the Higher Council for Science and Technology (HCST), Jordan, in collaboration with the Royal Geographical Society (with the Institute of British Geographers), with the Centre for Overseas Research and Development (CORD), Durham University, acting on behalf of RGS-IBG. RGS-IBG finished its involvement in the collaboration in 2000 and the programme continues to be a joint venture between Jordan and the UK, co-ordinated in the UK by CORD.

Project Patrons: HRH Crown Prince El Hassan and HRH the Duke of Kent

Programme Director: Mohammed Shahbaz of HCST, Jordan
Programme UK-Director: Dr Roderic Dutton, CORD, University of Durham.

The arid lands, or Badia, of north-east Jordan have been the subject of many forces of change throughout the course of the twentieth century, particularly since the end of the First World War. National boundaries drawn in the 1920s separated Jordan's Badia from similar areas in Syria, Iraq and Saudi Arabia. This meant that people living within these new boundaries became Jordanian and had to develop a set of relationships with the new Jordanian government in Amman which now provides basic services to the population including education, health care, electricity and water. Then in the 1930s the Iraq Petroleum Company built a pipeline through northern Jordan, creating the pumping station settlements of Ruwayshid and Safawi. Today, although some Badia pastoralists retain their traditional lifestyle of full mobility with their sheep and goats, most are only partially mobile for parts of the year or have adapted a fully settled way of life in a cluster of new villages. Vehicles have replaced camels for most forms of transport except desert police patrols, but a growing number of sheep and goats overgraze the natural vegetation and are

dependent on imported grain-based concentrates for survival during much of the year. Irrigated farming has been introduced and a network of paved roads has been built.

These many changes to the population, the resource base and the management of the Badia's natural resources are the subject of the Jordan Badia Research and Development Programme. Based at the excellent field centre at Safawi, 150kms east of Amman, in buildings at the old oil-pumping station known as H5, fieldwork began in 1992.

The Badia Programme study area comprises some 11,210 km² of the western half of the Jordan panhandle that extends north-east towards the boundary with Iraq, and is equal to around 14 per cent of the total land mass of Jordan.

The first requirement was to learn about the people and the physical environment of the study area. Thus a multiplicity of studies since 1992 has focused on all aspects of the traditional and changing pastoral livestock systems at a time

when the pastoral economy is under great strain because of changing external circumstances. Researchers have also made excellent progress with understanding the biodiversity and natural environment of the area, particularly its plants, mammals and birds. A series of studies of climate and of groundwater recharge, movement, chemistry and usage has very valuably added to national-scale studies by the government to reveal a picture of growing groundwater deficit. Parallel studies of geomorphological processes have begun to reveal the effects of wind, rainfall, surface water and agricultural activities on erosion of the basalt rocks and on soil structure. At the same time wider-scale studies of the area as a whole are being made possible by the acquisition of satellite imagery and digitised topographic and geological maps. Agricultural studies concern the sheep industry and there are social studies of domestic life, health and education. Demographically, the project has now shown that the population is likely to rise rapidly from 16,000 to 23,000 by the year 2013 losing complex questions for planners of education, health, services, the environment and the economy. A monograph, published by Kegan Paul International in March 1998, *Arid Land Resources and their Management: Jordan's Desert Margin*, edited by Dr Roderic Dutton, Professor John Clarke and Professor Anwar Battikhi contains 22 papers on research completed to 1998. A special edition to *Applied Geography*, 1999, contains 9 more papers. Under discussion in 2003 are another special edition of *Applied Geography* and a second monograph.

Much of the above work has been undertaken by established Jordanian and UK researchers, but the Programme has created the opportunity for active participation in the research by ten Jordanian and UK PhD students and the same number of Jordanians undertaking Masters by Research at different UK universities. This is doing more than anything else to strengthen the capacity of the Safawi Centre for its long-term research and development role.

The research is continuing and is now shaped by the new Scientific Action Plan for the Badia Programme prepared by the Higher Council for Science and Technology in Amman, in which are identified a series of research projects in the fields of population, water resources, livestock, land resources, energy and geology, environment, and the application of remote sensing and GIS technologies to a range of scientific questions.

In addition to the research there is now a stronger emphasis on development based on applied research. The Programme is providing its research data to Jordanian governmental and non-governmental organisations to incorporate into their planning and implementation work, and the Programme is becoming more actively engaged in pilot development schemes, testing ideas in partnership with the people. Thus, for example the Programme has embarked on a second phase of the livestock work aimed more overtly at integrating new with traditional approaches to livestock husbandry in order to increase productivity and income for the livestock owners. Planning meetings are being held between the Programme and Jordan's Royal Society for the Conservation of Nature (RSCN), and the authorities in the Badia together with the livestock owners, in order to reach agreement between all parties about a good and acceptable system for grazing sheep which will also improve both rangeland productivity and biodiversity. New work will consider the Badia's special requirements for health and education - shaped to fit the specific requirements of these remote and scattered communities.

Thus the Badia Programme has been able to combine modern approaches to information gathering with the traditional knowledge of the Bedouin as twin cornerstones to achieving an understanding of the geography of this important and characteristic region of the Middle East. We are learning that fragile as desert systems may be, they remain robust in terms of their ability to respond to change. Beneficial change, based on excellent research information, is needed to retain their vitality and viability.

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In March 1998 the Badia Programme was given a significantly higher status in Jordan establishing the Badia Programme as a National Centre. It therefore has much greater permanence and also much wider responsibility for all the arid Badia lands in Jordan (80% of the country's surface area), and much greater local financial support. This will enable long-term research and development activities there to be undertaken with greater confidence.

Major sponsors to date include:

Royal Jordanian, Land Rover, Smiths Industries, and Mr Gernot Langes-Swarovski, British Council, British Embassy, Amman, UK Department of Environment Darwin Initiative UK Department for International Development (formerly the UK Overseas Development Administration), UN-FAO, UNEP, GEF, USAID, Ministry of Planning in Jordan, USDA, Centre for Overseas Research and Development, University of Durham.

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JORDAN BADIA RESEARCH & DEVELOPMENT PROGRAMME 1996-2001

BIBLIOGRAPHY

Articles, Books, Monographs and Papers

a) Published

- Abu-Awwad, A.; Shatanswi, M., (1997) 'Water harvesting and infiltration in arid areas affected by surface crust: examples from Jordan.' *Journal of Arid Environments*, Vol. 37, No. 3, pp. 443-452.
- Abu-Hamdeh, N.H., (2000) 'Information and electrical technologies – Photovoltaic System Design for a Village of Farmers in Jordan Badia,' *Applied engineering in agriculture*, Vol. 16, No. 3, pp. 297-313
- Abu-Jaber, N.S.; Ali, A.J. ; Qudah, K.N., (1998) 'Use of Solute and Isotopic Composition of Ground Water to Constrain the Ground Water Flow System of the Azraq Ares, Jordan' *Ground water*, Vol. 36, No. 1, pp. 69-80.
- Al-Akour, R., (1998) 'Improvement of the health service,' In Dutton, R.W.; Clarke, J.I. and Battikhi, A. eds. (1998), *Arid land resources and their management: Jordan's desert Margin*, Kegan Paul International, London, Vol. 1 pp 291-298.
- Al-Eisaw, D.; Edwards, M.; Millington, A., (1996) ' The Use of ERS ATSR-2 DATA for Monitoring Rangeland Vegetation in the Eastern Badia, Jordan,' In Donoghue, Daniel and Zong, Y. eds., (1996), *Remote Sensing, Science and Industry*, pp 29-36.
- Al-Homoud, A. S.; Allison, R. J. ; Sunna, B.F.; White, K., (1996) 'A study on geology, geomorphology, hydrology, groundwater, and physical resources of the desertified Badia environment in Jordan towards sustainable development.' *Environmental geology and water sciences*, Vol. 27, No.3, pp.198.
- Al-Homoud, A. S.; Sunna, B. F.; Allison, R. J.; Higgitt, D.L.; White, K., (1998) 'Regional geologic environs and natural resources and Badia Sector, Jordan.' *Environmental geology*, Vol. 36, No. 1-2, p18-26.
- Al-Homoud, A.S., (1995) 'Geology, geomorphology, hydrology, groundwater and physical resources of the desertified Badia environment in Jordan,' *GeoJournal*, Vol. 37, No. 1, pp. 51-67.
- Al-Homoud, A.S.; Allison, R.J.; Sunna, B.F., (1996) 'A study on geology, geomorphology, hydrology, groundwater and physical resources of the desertified Badia environment in Jordan towards sustainable development,' *Environmental geology and water sciences*, Vol. 27, No.3, p198.
- Al-Homoud, A.S.; Sunna, B.F.; Allison, R.J.; Higgitt, D.L.; White, K., (1998) 'Regional geologic environs and natural resources and Badia Sector, Jordan,' *Environmental geology*, Vol. 36, Nos. 1-2, pp18-26.
- Allison, R. J.; Higgitt, D.L., (1999) 'Clast Exposure on Boulder-Covered desert slopes', *Earth Surface Processes & Landforms*, Vol. 24, pp. 111-125, figs, tables. (PR JBP 7.037)
- Allison, R. J., (2001) 'Surface and groundwater resources survey in Jordan.' *Geological Society Special Publication*, Vol. 18, pp. 65-71.
- Allison, R. J.; Higgitt, D.L.; Kirk, A.J.; Whrburton, J.; Al-Homoud, A.S.; Sunna, B.F.; White, K., (1998) 'Geology, geomorphology, hydrology, groundwater and physical resources.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A., (1998) *Arid land*

- resources and their management: Jordan's desert margin. London, Kegan Paul International, Vol, 1, pp. 21-46.
- Allison, R. J.; Rosser, N.J.; Whrburton, J.; Rose, J.R.; Higgitt, D.L.; Kirk, A., (2000) 'Geomorphology of the eastern Badia basalt plateau, Jordan.' *Geographical Journal*, Vol. 166, No. 4, pp.352-370.
- Allison, R.J.; Higgitt, D.L., (1998) 'Slope form and associations with ground boulder cover in arid environments, northeast Jordan', *Cantena*, Vol. 33, pp. 47-74. (PR JBP 7.036)
- Al-Rousan, N.; Petrie, G., (1998) 'System calibration, geometric accuracy testing and validation of DEM and orthoimage data extracted from SPOT stereo pairs using commercially available image processing systems.' *International archives of photogrammetry and remote sensing*, Vol. 32, No.4, p8.
- Al-Rousan, N.; Zoj, M. J. V. et al., (1997) 'Automated DEM extraction and orthoimage generation from SPOT Level 1B imagery.' *Photogrammetric engineering and remote sensing*, Vol. 63, No.8, pp. 965-974.
- Batayneh, A. T.; Al Zoubi, A.S. et al., (2001) 'Geophysical investigations for the location of a proposed dam in Al Bishriyya (Al Aritayn) area, northeast Badia of Jordan.' *Environmental geology*, Vol.40, No.7, pp.918-922.
- Battikhi, A.; Millington, A.; Tansey, K.; White, K., (1996) 'Relationships Between Surface Roughness and ESR-1 SAR Backscatter on Desert Surfaces in Eastern Jordan: Preliminary Results,' In Donoghue, Daniel and Zong, Y. eds., (1996), *Remote Sensing, Science and Industry*, pp 45-52.
- Brandenburg, C., (1998) 'Development anthropology: a primary survey'. In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International, Vol. 1, pp. 247-266.
- Brandenburg, C., (1998) 'Preliminary findings of a health and education survey'. In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 279-290.
- Campbell, D.; Rowe, A., (1998) 'Results of a preliminary survey of livestock owners'. In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp 189-196.
- Clarke, J.; Noin, D. P. P. et al., (1998) *Population and environment in arid regions*. New York, UNESCO, Parthenon.
- Cope, T. A.; El-Eisawi, D., (1998) 'Checklist of the flora'. In Dutton, R.W.; Clarke, J.I.; Battikhi, A., (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 183-188.
- Donoghue, ; Daniel, ; Zong, Y., (eds.), (1996) *Remote Sensing, Science and Industry*. Proceedings of the 22nd Annual Conference of the Remote Sensing Society 11-14 September 1996, University of Durham. Published by the Remote Sensing Society, University of Nottingham. RGS-IBG Special Session on the Jordan Badia Project, pp 15-60.
- Dottridge, J., (1998) 'Water resources quality, sustainability and development.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp 67-80.
- Dottridge, J.; Gibbs, B., (1998) 'Water for sustainable development.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A., (eds.) *Arid land resources and their management: Jordan's desert margin*.

- London, Kegan Paul International. Vol. 1, pp 111-118.
- Dottridge, J.; Jaber, N. A., (1999) 'Groundwater resources and quality in northeastern Jordan: Safe yield and sustainability.' *Applied Geography* Vol. 19, No. 4, pp. 313-324.
- Drury, D., (1998) 'Baseline hydrochemical study of the Azraq basin.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.), *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 81-86.
- Dutton, R. and S. M. (1999) 'The Badia Programme: Defining and overcoming constraints on sustainable development.' *Applied Geography* Vol, 19, No. 4, pp. 275-282.
- Dutton, Roderic W and Shahbaz, Mohammad I (eds.) (2008) *Jordan's arid Badia: deepening our understanding*. Cambridge: Smith-Gordon and company, Cambridge. ISBN 978-1-85463-227-2.
- Dutton, R. W., (1998) 'Population, environment and development.' *Arid land resources and their management: Jordan's desert margin*. In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.), *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 1-20.
- Dutton, R. W.; Donoghue, D. N. M.; Ashour, R., (1996) 'Geographical Data Management for the Badia Programme,' In Donoghue, Daniel and Zong, Y., (eds.) (1996), *Remote Sensing, Science and Industry*, pp 21-28.
- Dutton, R.W., (1995) 'The Jordan Badia Programme: Population - environment interactions,' in Clarke, J. (ed), (1995) *Population and environment in arid lands*, Oxford University Press, pp. 21, biblio. (PR JBP .022)
- Dutton, R.W.; Clarke, J.I.; Battikhi, A.M., (eds.) (1998) *Arid Land Resources & their Management: Jordan's Desert Margin*, Kegan Paul International Ltd., PO Box 256, London, WC1B 3SW. 332pp
- Edwards, M. C.; Wellens, J. et al. (1999) 'Monitoring the grazing resources of the Badia region, Jordan, using remote sensing.' *Applied Geography* Vol, 19, No. 4, pp. 385-398.
- Edwards, M., D.; Al-Eisawi, et al. (1996) *The use of ERS ATSR-2 DATA for monitoring rangeland vegetation in the eastern Badia, Jordan*. Proceedings of the 22nd annual conference of the Remote Sensing Society: remote sensing, science and industry, University of Durham, Remote Sensing Society.
- Findlay, A. M. and M. Maani (1999) 'Development implications of demographic trends and projections for an arid region: The case of the Badia Research and Development Project area of Jordan.' *Applied Geography* Vol. 19, No. 4, pp. 283-298.
- Findlay, A. M.; Maani, M. (1998) 'Population fertility trends' in Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 197-214.
- Findlay, A.M.; Maani, M., (1995) 'Fertility trends in an arid environment: The case of the population of the Jordanian Badia,' in Clarke, J. (ed), (1995) *Population and environment in arid lands*, Oxford University Press. 18 pp. (PR JBP 5.026)
- Haaland, A. (1998) 'Hydrogeology and hydrochemistry of the Sirhan and Hammad basins'. In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol.1, pp. 95-102.
- Higgitt, D. L.; Allison, R.J., (1999) 'Characteristics of stone covers on the surface of basalt flows in arid, northeast Jordan.' *Geomorphology* Vol. 28, Nos.3-4, pp. 263-280.
- Higgitt, D. L.; Allison, R.J., (1998) 'Characteristics of basalt boulder surfaces.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources*

- and their management: *Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp.171-182.
- Higgitt, D. L.; Allison, R.J. (1999) 'Clast exposure on boulder-covered desert slopes.' *Earth surface processes and landforms* Vol. 24, No.2, pp. 111-125.
- Holden, W. (1998) 'Modelling and isotope study of the Azraq basin.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp.87-94.
- Kirk, A. J. (1998) 'A synthesis of climatic data with specific interest in the precipitation record'. In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 47-66.
- Kirk, A. J. (1998) 'The effect of intensive irrigated agriculture upon soil degradation: a case study from Ashrafiyya.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 127-156.
- Maani, M.; Hunaiti, H. et al. (1998) 'Demographic change and populations projections, 1976-2013.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 215-246.
- Mackay, G.; Millington, A.; White, K. (1996) 'Directional Reflectance Properties of Desert Surfaces, The Eastern Badia, Jordan,' In Donoghue, Daniel and Zong, Y. eds., (1996), *Remote Sensing, Science and Industry*, pp 37-44.
- McGwire, K. (1996) 'The NASA Landsat Pathfinder Programme Global Land Cover Test Sites Project,' In Donoghue, Daniel and Zong, Y. eds., (1996), *Remote Sensing, Science and Industry*, pp 15-20
- Millington, A.; al-Hussein, S.; Dutton, R. (1999) 'Population dynamics, socioeconomic change and land colonization in northern Jordan, with special reference to the Badia Research and Development Project area.' *Applied Geography*, Vol. 19, No. 4, pp. 363-384.
- Naya, C. (1998) 'Women and unpaid work in Nayifa village.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol.1, pp. 267-278.
- Noble, P. (1998) 'Quantification of recharge to the Azraq basin.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp. 103-110.
- Petrie, G. 'Automatic DEMs and orthoimages from SPOT stereo-pairs. SPOT DEMs of Jordan.'
- Rowe, A. G. (1999) 'The exploitation of an arid landscape by a pastoral society: The contemporary eastern Badia of Jordan.' *Applied Geography*, Vol. 19, No.4, pp. 345-362.
- Scott, D. M.; Dunstone, N. (2000) 'Environmental determinants of the composition of desert-living rodent communities in the north-east Badia region of Jordan.' *Journal of Zoology* Vol. 251, No.4, pp. 481-494.
- Spicer, N. (1999) 'Pastoral mobility, sedentarization and accessibility of health services in the northeast Badia of Jordan.' *Applied Geography*, Vol. 19, No. 4, pp. 299-312.
- Spicer, N. J. (1998) 'Sedentarization and accessibility to health services'. In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. **1:** 299-308.
- Tansey, K.; Millington, A. (2001) 'Investigating the potential for soil moisture and surface roughness monitoring in drylands using ERS SAR data.' *International Journal of Remote Sensing*, Vol. 22, No.11, pp. 2129-2149.

Tansey, K. J.; White, K.H.; Millington, A.; Battikhi, A.M (1999) 'Monitoring soil moisture dynamics using satellite imaging radar in northeastern Jordan.' *Applied Geography*, Vol.19, No.4, pp. 325-344.

Tansey, K.; White, K.; Battikhi, A.M.; Millington, A. (1996) *Relationships between surface roughness and ERS-1 SAR backscatter on desert surfaces in eastern Jordan: preliminary results*. Proceedings of the 22nd annual conference of the Remote Sensing Society: remote sensing, science and industry, University of Durham, Remote Sensing Society.

Taqqueddin, S. A.; Al-Homoud, A. S.; Awad, A.; Ayyash, S.(1995) 'Geological and hydrological investigations of a water collection system in arid Jordanian lands.' *Environmental geology*, Vol 26, No. 4, pp. 252-261.

Waddingham, J. (1998) 'Water demand.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International. Vol. 1, pp.119-126.

Warburton, J. (1998) 'A reconnaissance survey of surface water infiltration characteristics.' In Dutton, R.W.; Clarke, J.I.; Battikhi, A. (eds.) *Arid land resources and their management: Jordan's desert margin*. London, Kegan Paul International, Vol. 1, pp.157-170.

White, K. (1996) 'Spectral Reflectance Characteristics of Basalt Surfaces, eastern Badia, Jordan,' In Donoghue, Daniel and Zong, Y. eds., (1996), *Remote Sensing, Science and Industry*, pp 53-62.

Zaitoun, S. T.; Al-Ghzawi, A.M. A.; Shannay, H.K. (2001) 'Grooming behaviour of *Apis mellifera syriaca* towards *Varroa jacobsoni* in Jordan.' *Journal of Applied Entomology* Vol. 125

Newspapers and Magazines

Brace, M (1995) A Lifeline for the Beduin, *The Times*, 14 April 1995 (PR JBP 7.038)

Eigland, Tor (1997) Understanding the Badia, *Aramco World*, Nov/Dec 1997, pp10-17.

(PR JBP 7.034)

Miller, P. (1994) The Jordan Badia Research and Development Programme, *Science & Technology Now*, Spring 1994, Issue 3, pp. 13 – 15. (PR JBP 7.039)

Pallister, D. (1998) Pastures Few. *The Guardian* May 13 1998, pp4-5. (PR JBP 7.035)

Pearce, Fred (1995) Shepherds and wise men. *New Scientist* 23-30 December 1995, pp. 24 – 27.

Sykes, L. (1996) The Human Factor, *The Geographical Magazine*, August 1996, pp. 24 – 27. (PR JBP 7.040)

b) Internal Reports

Abu Ashour, R. S. (1998) *An evaluation of geographical information systems for surface water studies in the Badia region of Jordan*. Geography. Durham, Durham.

Akkad, B. (1997) *The use of Landsat imagery and GIS for monitoring vegetation biodiversity in arid areas of Jordan*. Geography. Durham, Durham: 103.

Al Ayyash, S.(1995) *Biomass mapping at Marab Swi'ad in 1995*, Programme Report.

Al-Akour, R.(1994) *Improvement of health in the Jordan Badia Research and Development Programme area*, University of Jordan, pp. 34, fig. (PR JBP 5.025)

Al-Dajani, R. L. (2001) *Bedouin livelihoods: the role of women in the Jordanian Badia*. Geography. Durham, Durham: 190.

al-Hussein, S. (2000) *GIS modelling of land degradation in northern Jordan using satellite imagery*. Geography. Leicester, Leicester.

Allison, R.J. et al., (1992) *Geomorphology and physical resources, report no. 1*. University of Durham, 73 pp. (PR JBP 1.003)

Allison, R.J. et al., (1993) *Geomorphology and physical resources, report no. 2*, University of Durham, 48 pp. (PR JBP 1.004)

Al-Nabhan, M.; Al-Qaz'an, M.,(1994) *The educational situation in the area of research and improvement of Jordan*, Central Publications Series, No. 33, in Arabic, map, fig., tab. (PR JBP 6.028)

- Al-Oun, S. S. (1998) *Livestock marketing in the Jordanian Badia*. Geography. Durham, Durham.
- Al-Rousan, N. (1998) *Systematic calibration, geometric accuracy testing and validation of DEM and orthoimage data extracted from SPOT stereo-pairs using commercially available image processing systems*. Geography and topographic sciences. Glasgow, Glasgow.
- Al-Sharafat, M. M. (2001) *Government policies affecting the sheep industry in the northern Jordanian Badia and Bedouin responses*. Geography. Durham, Durham: 174.
- Al-Sirhan, S. M. (1998) *Managing rangelands: learning from institutional experience in order to promote Bedouin participation in the Badia of Jordan*. Geography. Durham, Durham: 137.
- Al-Sirour, M. (1999) *Changing geographic patterns of pastoralists' mobility: a study of the Bedu in north-east Jordan*. Geography and topographic sciences. Glasgow, Glasgow: 229.
- Al-Tabini, R. J. (2001) *An evaluation of the potential of *Atriplex nummularia* for sheep production in the arid Jordanian rangelands: the effects of defoliation management*. Agriculture. Newcastle-upon-Tyne, Newcastle-upon-Tyne: 255.
- Brandenburg, C., (1993) *Development anthropology, a primary survey, part I, summer 1993*. School of Oriental & African Studies, University of London, 22 pp. (PR JBP 3.011)
- Brandenburg, C., (1995) *Health and education survey, summer 1994*, Preliminary findings, School of Oriental & African Studies, University of London, pp. 15. (PR JBP 5.020)
- Campbell, D.;Roe, A., (1995) *Results of a preliminary survey of livestock owners in the Badia Research and Development Programme area, ODA and Smiths Industries Research associates*, pp. 9. (PR JBP 1.021)
- Cope, T.A., (1992) *Botanical survey, phase I*, Royal Botanic Gardens, Kew, 38 pp. (PR JBP 1.001)
- Cope, T.A., (1993) *Botanical survey, phase II*, Royal Botanic Gardens, Kew, 13 pp. (PR JBP 1.002)
- CORD (1994) *Jordan Badia Research & Development Programme: Background information for Johnston Pipes*, 25/10/95, 11pp. (PR JBP 7.041)
- Dottridge, N.J., (1994) *Groundwater resources and quality*, University College London., 15 pp. (PR JBP 3.010)
- Dottridge, N.J., (1995) *Water Resources: Progress and Priorities*, University College London. 26 pp. (PR JBP 5.023)
- Doyle, J. (2001) *The application of GIS to illustrate inequalities in access to primary healthcare services throughout Jordan with special reference to the Badia region of the country*. Geography. Durham, Durham: 69.
- Edwards, M. C. (1999) *Detection and monitoring of arid grazing land vegetation using ATSR-2 and geometric optical modelling*. Geography. Leicester, Leicester.
- Farnworth, J. (1993) *Survey and recommendations for irrigated agriculture*, 10 pp. (PR JBP 1.005)
- Findlay, A.M.; Briggs, J.; Maani, M., (1994) *Fertility trends in the Badia of Jordan: an evaluation of the relationship between reproduction and production in an arid environment*, Universities of Dundee, Glasgow and Jordan, 23 pp, tab., fig., biblio. (PR JBP 4.019)
- Garnett, A., (1995) *A study into milk yields of Jordanian Awassi Sheep in Bedouin flocks studied in the North Badia from February to July 1995*, T.A.A.F. posting final report, unpaginated. (PR JBP 6.030)
- Maani, M.; Hunaiti, H.; Findlay, A.M., (1995) *Demographic change and population projections for the Badia region of Jordan, 1976-2013*, University of Dundee, 38 pp., tab., fig., biblio. (PR JBP 6.029)
- Nawasreh, M. K. A. (2001) *Investigations of Jordanian industrial minerals*. Engineering geology. Cardiff, Wales: 331.
- Papadopulos, J. V. C. (1999) *Response by sheep*



- milking pastoralist households in Jordan to the withdrawal of an input subsidy and related market, environmental, social and policy implications.* Agricultural economics. London, Wye College, University of London: 415.
- Roe, A. G. (2000) *Pastoral livelihoods: changes in the role and function of livestock in the northern Jordanian Badia.* Geography. Durham, Durham: 241.
- Scott, D. M. (2000) *Aspects of the ecology of desert-living rodents in the north-east Badia region of Jordan.* Biological sciences. Durham, Durham: 232.
- Spicer, N. J. (2000) *Health care in sedentarising communities: a case study in the Jordan Badia.* Geography and topographic sciences. Glasgow, Glasgow: 301.
- Spicer, N., (1995), *The creation of a digital elevation model of the Badia region of Jordan and the extraction of geomorphological information,* Preliminary site visit report, University of Glasgow, 11 pp.
- Tansey, K. J. (1999) *Monitoring and modelling surface moisture in north-east Jordan using ERS SAR data.* Geography. Leicester, Leicester.
- c) Unpublished**
- Bayliss, J.P., (1995) *Analysis of correlations between sediment size and moisture content with spectral reflectance values from the Marab Suwei'id of the Wadi Ebd in the Badia region of Jordan,* 3rd year undergraduate dissertation, University of Durham, var. pagination. (PR JBP 6.027)
- Cuthill, V., (1993) *The distribution of lichens in the eastern Badia, Jordan,* Third year undergraduate dissertation, University of Reading, unpaginated. (PR JBP 3.013)
- Drury, D.M., (1993) *The hydrogeology and hydrochemistry of basaltic aquifers. A literature review,* University College London, pp. 31. (PR JBP 2.007)
- Drury, D.M. (1993) *The hydrogeology of the Azraq Basin, north-east Badia, Jordan,* M.Sc. thesis; University College London, pp. 79. (PR JBP 1.006)
- Francis, D., (1995) *The creation of a digital elevation model of the Badia region of Jordan and the extraction of geomorphological information,* MSc. Thesis, University of Durham. 92 pp. (PR JBP 7.031)
- Gibbs, B.R., (1993) *Repercussions of aquifer exploitation - with an emphasis on wetlands. A literature review,* University College London, pp. 42. (PR JBP 3.009)
- Gibbs, B.R., (1993) *The hydrogeology of the Azraq Basin, north-east Badia, Jordan,* M.Sc. thesis, University College London pp. 238. (PR JBP 2.008)
- Holden, W., (1995) *Modelling and isotope study of the Azraq basin, north-east Jordan* MSc. Thesis, University College London, 134 pp. (PR JBP 7.032)
- Kirk, A.J., (1994) *The effects of soil crusting on sediment dynamics and soil quality in north-eastern Jordan,* Graduate discussion paper, Department of Geography, University of Durham, unpaginated. (PR JBP 4.015)
- Kirk, A.J. & Allison, R.J. (1994) *Soil Crusting in Arid Environments,* Abstract for British Geomorphological Research Group Annual meeting, 16-18/9/94. (PR JBP 7.042)
- Lewis, E., (1994) *The morphological and magnetic evolution of desert pavements in the eastern Badia of Jordan,* Third year undergraduate dissertation, University of Reading, unpaginated. (PR JBP 3.014)
- Meani, M.; Hunaiti, H.; Findlay, A.M., (1995) *Demographic change and population projections for the Badia region of Jordan, 1976-2013,* University of Dundee, pp. 38, tab, fig., biblio. (PR JBP 7.029)
- Newton, D., (1993) *Survey of the vegetation on a playa and wadi in the Badia of Jordan,* Third year undergraduate dissertation, University of Reading. (PR JBP 1.012)
- Noble, A.P., 1994) *Quantification of recharge to the Azraq Basin, north-east Badia, Jordan,* M.Sc. thesis, University College London, pp. 89. (PR JBP 4.017)
- Spicer, N., (1995) *Health care provision and utility*

- in the Jordan Badia: a demographic study, pp. 11.(PR JBP 7.033)
- Stobbs, R.M. (1994) *Soil moisture retention characteristics of arid zone fluvial sediments*, Third year undergraduate dissertation, University of Liverpool, pp. 89, tab., plates, biblio. (PR JBP 1.018)
- Waddingham, J.T., (1994) *Water demand in the north-east Badia, Jordan*, M.Sc. thesis, University of Newcastle upon Tyne. (PR JBP 4.016)
- Warburton, J., (1995) *A reconnaissance survey of surface water infiltration in the Eastern Badia*, University of Durham, in preparation.
- Wintersgill, O., (1994) *Economic differences between villages in the Badia region of Jordan*, M.A. thesis, University of Durham, unpaginated. (PR JBP 5.024)
- d) BRDP Reports (published and unpublished)**
BRDP reports held at Durham University
 (contact r.w.dutton@durham.ac.uk)
- Ali-Disi, A.m. (1997). *Reptile Survey, October to December 1996*. Amman, CORD/BRDP, RSCN: 70 Plus Annexes
- Al-Jazi, N. and B. Qarraleh (2001). *A report of workshops about the effective use of the manuals and posters (14-28/ June/ 2001)*. CORD/BRDP: 19
- Allison, R.J., A. Al-Homoud, et al. (1992). *Geomorphology and physical resources, report no. 1*, University of Durham, BRDP Report: 73
- Amr, Z. (1998). *The Carnivores of the Badia Project area*, University of JUST, BRDP report: 29
- Andrews, I.J. (1999). *Some comments on birds seen at As-Safawi and other sites in the basalt desert (NE Jordan) in September and October 1998*, BRDP report: 13
- Andrews, I.J. (1999). *The Ornithological importance of Ghadir Burqu (NE Jordan), with particular reference to observations made in September and October 1998*, BRDP report: 17
- Armstrong, T, P. Gotham, et al. (1999). *Systematic list of birds at Burqu pool, Safawi and other sites in the Badia region of Jordan, September/October 1998*, BRDP report: 9
- Armstrong, T. and R. Leavett (1999). *Some recommendations towards conservation measures and the development of eco-tourism in the Badia with reference to Ornithological interests*, BRDP report: 7
- Bisson, A., N. Tamimi, et al. (2002). *Certificates and forms for accreditation and monitoring of the CAHWs' work, on the CAHW project*, Jordan, CORD/BRDP.
- Bisson, A., N. Tamimi, et al (2001). *Basic medicines manual for CAHEWs, with fully illustrated pages on 11 basic medicines*. University of Durham, CORD/BRDP Report from the DIFD Livestock Development Project, 1994-2001: 11
- Bisson, A., N. Tamimi, et al (2001). *Vaccination manual for CAHEWs, with fully illustrated pages on anthrax, brucella, goat pox, coccidian, sheep pox, PPR and foot and mouth*. (Arabic), University of Durham, CORD/BRDP Report from the DFID-funded Livestock development project, 1994-2001:13
- Bisson, A., N. Tamimi, et al. (2001). *Basic medicines training manual*, CORD/BRDP: 12
- Bission, A., N. Tamimi, et al (2001). *Vaccination training manual*, CORD/BRDP: 12
- Bisson, A. (2000). *Report of the CAHEW project poster presentation at the annual general meeting of the Veterinary Association, 2000*. Amman, CORD/BRDP: 6 (English and Arabic)
- BRDP/CORD (2002). *Conclusions and recommendations to H.E. the Minister of Agriculture. Workshop on: Alternative animal health services delivery strategies (Jan 2001); Community-based animal health and extension workers (CAHEWs or paravets) – current progress and the future (April 2001)*. Amman, CORD/BRDP: 2
- Brown, K. (1997). *Interim report on the Badia flora biodiversity studies*, University of Durham, BRDP Report: 14

- Campbell, D. and S. Rkaybat (2000). *Extension training resources manual (Arabic)*, University of Durham, CORD/BRDP Report from the DFID-funded livestock development project, 1994-2001: 365
- Campbell, D. and S. Rkaybat (2000). *Extension training resources manual: sheep and goats section (Arabic)*, University of Durham, CORD/BRDP Report from the DIFD-funded livestock development project, 1994-2001: 365
- Dunstone, N. and D. M. Scott (1997) *Interim report on the mammal biodiversity studies conducted in the Badia of north east Jordan*, University of Durham, BDRP report: 16
- Dutton, R. W. (1999). *Darwin initiative for the protection of species project: Management of biodiversity in the Badia region, north-east Jordan, annual report year four*, CORD, University of Durham, BRDP report: 14
- Dutton, R. W. (1998). *Darwin initiative for the protection of species project: Management of biodiversity in the Badia region, north-east Jordan, annual report year three*, CORD, University of Durham BRDP report: 12
- Dutton, R. W. (1997). *Darwin initiative for the protection of species project: Management of biodiversity in the Badia region, north-east Jordan, annual report year two*, CORD, University of Durham BRDP report: 13
- Dutton, R. W. (1996). *Darwin initiative for the protection of species project: Management of biodiversity in the Badia region, north-east Jordan, annual report year one*, CORD, University of Durham BRDP report: 12
- Dutton, R. W. and A. Bisson (2001). *Some key conclusions about future systems for delivering livestock health services in Jordan (with special reference to sheep and goats), drawn from two workshops, on: Alternative animal health services delivery strategies (Jan 2001); Community-based animal health and extension workers (CAHEWs or paravets) – current progress and in the future (April 2001)*. Amman, CORD/BRDP: 6
- Dutton, R. W., A. Bisson, et al. (2001). *Conclusions and recommendations from the stakeholder meeting on ‘CAHEWs and their implications’, September 16th-17th 2001* CORD/BRDP: 4
- Dutton, R. W., S. Mashaqbah, et al. (1997). *Interim report on the Badia pastoral interaction studies*, CORD, University of Durham BRDP report: 9
- Dutton, R. W. and M. Shahbaz (2001). *BRDP/CORD DIFD-funded Badia livestock development project, 1998-2001: final technical and financial report for the Ministry of Planning, Jordan*, University of Durham, CORD/BRDP Report from the DFID-funded livestock development project, 1994-2001: 26
- Farnworth, J. (1993). *Survey and recommendations for irrigated agriculture*, CORD, University of Durham, BRDP report: 10
- Hinchcliffe, G., B. Elliott, et al (1997). *Bat survey – April/May 1997* CORD, University of Durham and JUST Jordan, BRDP report: 15
- Maddox, T., A. Burrows, et al. (1997). *The Durham University biodiversity expedition: the Badia, Jordan, 1996*. Durham, University of Durham, BRDP report: 92.
- Oakeley, R. (1996). *The use of supplementary animal feed in the Jordan Badia: a study of livestock producer perceptions and understanding of sheep and goat feed alternatives, and their related values*, CORD/BRDP project report: 61
- Oakeley, R. (1997). *Economic and policy trends affecting the production and marketing systems for small ruminants in the northeast Badia, Jordan*, CORD/BRDP project report: 61
- Oakeley, R. and R. Tabini (1996). *The nature and significance of livestock trading in the north-east Badia of Jordan*, CORD/BRDP: 28
- Oughton, E. A. and W. Adas (1999). *Report on the baseline study of households, Jordan*



- BRDP: a socio-economic study of the role of livestock in the domestic economy of households in the north-east Badia*, University of Durham BRDP report from the DFID-funded livestock development project, 1994-2001: 40.
- Oughton, E. A. and W. Adas (2001). *Report on the endline study of households, Jordan BRDP: a socio-economic study of the role of livestock in the domestic economy of households in the north-east Badia*, University of Durham, BRDP report from the DFID-funded livestock development project, 1994-2001: 40
- Petrie, G. (1995). *The creation of a digital evaluation model of the Badia region of Jordan and the extraction of geomorphological information, preliminary site visit report*, University of Glasgow, BRDP report: 11
- Pierce, D.W. (2000). *Extension specialist support [8] to the DFID-funded livestock extension project of the Badia programme, 12-22 August 2000. Report of the 8th consultancy*, University of Wolverhampton, Centre for rural development and training. CORD/ BRDP report: 12 (plus annexes).
- Pierce, D.W. (2000). *Extension specialist support [7] to the DFID-funded livestock extension project of the Badia programme, 12-25 May 2000. Report of the 7th consultancy*, University of Wolverhampton, Centre for rural development and training. CORD/ BRDP report: 13 (plus annexes).
- Pierce, D.W. (2000). *Extension specialist support [5] to the DFID-funded livestock extension project of the Badia programme, 28th Jan to 10th Feb 2000. Report of the 5th consultancy*, University of Wolverhampton, Centre for rural development and training. CORD/ BRDP report: 13 (plus annexes).
- Pierce, D.W. (2000). *Extension specialist support [2] to the DFID-funded livestock extension project of the Badia programme, November 1998. Report of the 2nd consultancy*, University of Wolverhampton, Centre for rural development and training. CORD/ BRDP report.
- Pierce, D.W. (1999). *Extension specialist support [4] to the DFID-funded livestock extension project of the Badia programme, 16-26 July 1999. Report of the 4th consultancy*, University of Wolverhampton, Centre for rural development and training. CORD/ BRDP report: 13 (plus annexes).
- Quatrameez, M. M. (1997) *Bat survey, BRDP area, December 1996*, CORD, University of Durham and RSCN Jordan, BRDP report: 25
- Ray, D. E. (1999). *Extension specialist support [3] to the DFID-funded livestock extension project of the Badia programme, 7-17 March 1999. Report of the 3rd consultancy*, University of Wolverhampton, Centre for rural development and training. CORD/BRDP report: 13 (plus annexes).
- Rowe, A (1998). *Bedouin livestock management and socio-economics in the JBRDP area*. Report to the Jordan BRDP, CORD/BRDP: 90
- Thomas, C. J. (1997). *Interim report on the avian biodiversity studies*, University of Durham, BRDP report: 10
- Ward, R. M. (1998). *Birds of the Badia region of Jordan, spring 1997*, University of Durham BRDP report: 8