Land use, climate change and water availability: Phase 2a

Rapid Evidence Assessment: List of articles for review at full text

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Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Disclaimer

Forward

This report presents progress in a Rapid Evidence Assessment (REA) to address the question "Can land use and land management make a difference to water availability under conditions of climate change?" The report presents the draft list of articles for review at full text.

This project is commissioned by the Department for Environment, Food and Rural Affairs (Defra) and co-funded by Defra and the Natural Environment Research Council (NERC). It represents a continuation of activity initiated under the Environment Sciences to Services Partnership (ESSP). The ESSP is a joint initiative between the British Geological Survey (BGS), Centre for Ecology and Hydrology (CEH), Defra, Environment Agency, Met Office, NERC and Ordnance Survey.

The REA team is based at the Centre for Ecology & Hydrology (CEH). The team is lead by David Boorman and includes Helen Houghton-Carr and Kay Heuser. James Miller has provided advice and guidance to the team.

The REA team reports to a Project Board which is lead by Henry Leveson-Gower (Defra) and includes David Boorman (CEH), Ian Holman (Cranfield University), Andrew Hughes (British Geological Survey; BGS), David Seccombe (Environment Agency; EA) and Rob Soley (AMEC).

The time frame for this REA requires the Project Board to feedback comments on draft documents within 1 week of receipt. Comments should be emailed to David Boorman dbb@ceh.ac.uk. Lack of feedback within that period will be assumed to indicate approval.

At this stage of the REA, there is an opportunity for each Project Board member to put forward any additional articles considered relevant to the review – a maximum of three per Board member - such as grey literature or specialist papers not uncovered by the search strategy. These additional papers will enter the process at the final stage. However, they must contain original evidence, not just assertion or opinion, or espouse best practice, without evidence. Similarly modelling studies that only explore simulated changes without supporting data cannot supply evidence. Evidence can only be included once: different papers referring to the same data, or repeating results from other papers, do not represent additional evidence. Please remember these points when nominating additional articles.

The deadline for nomination of additional articles (up to three per Project Board member), is 21st June 2013.

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Glossary

Online databases and websites

BIOSIS	Life and biomedical sciences. Part of Web of Knowledge. http://apps.webofknowledge.com/
Google	Web search engine for any publically available online literature. www.google.co.uk
Google Scholar	Web search engine for "scholarly" literature. http://scholar.google.co.uk/
MEDLINE	US National Library of Medicine database. Part of Web of Knowledge. http://apps.webofknowledge.com/
Scopus	Scientific, technical, medical, and social sciences (including arts and humanities). www.scopus.com
Web of Knowledge	Academic citation indexing and search service combined with web linking. http://apps.webofknowledge.com/
Web of Science	Sciences, social sciences, arts and humanities. Part of Web of Knowledge. http://apps.webofknowledge.com/

1. Introduction

1.1 Background

A Rapid Evidence Assessment (REA) is being carried out to review the evidence that interactions between climate change and land use and management can affect water availability. The REA aims to capture as unbiased and comprehensive a sample as possible of published literature to provide an overview of the available evidence. Houghton-Carr *et al.* (2013) present the protocol detailing the REA objectives and the process that is being undertaken to complete the REA. The protocol discusses the question that guides the scope of the review, the strategy for the search, refinement and extraction of evidence, and the subsequent synthesis of that evidence. Expert opinion is not being used to force the outcome of what is effectively a systematic literature search in any particular direction.

The time frame for this REA is 14 weeks. This is comprised of two weeks to develop the protocol, eight weeks to conduct the review, the preliminary results of which will be presented at a stakeholder workshop on 1st July 2013, and a further four weeks to finalise the review results and complete the associated report.

1.2 Discussion of Project Board comments on the Draft REA Protocol

The search strategy presented in the REA protocol was developed through discussion within the REA team, in depth analysis of the question, some initial scoping, and feedback from the Project Board. The Project Board comments covered a wide range of ideas as to how the protocol might be improved. Several of these were easy to address by modifications to the search terms presented in Table 3.1 of that document. Regarding the five-part search string (P1 to P5):

- There were comments about the two distinct elements for surface water and groundwater (P1), and whether the terms associated with these in P2 should apply equally to both. In addition, there was an issue around “groundwater” and “ground water”. The two elements have now been combined and the P1 string modified to “*water*”.

- Additional elements have been added in P2 so that it now includes discharge and soil drainage. “watertable” has been added in addition to “water table”.

- The “water availability” and “water quantity” terms in P3 have been made more generic to pick up more articles e.g. also include “availability of water”, “water resource* availability”, etc.

- P5 has been changed to include “chang*” and “differen*” in addition to “increas*” and “decreas*”.

The issue, raised by the Project Board, around the term “water availability” in P3 is interesting. It is in the title of the project and in the primary question that is the basis of the project objective, so it is difficult to exclude the term despite the increasing appreciation that precisely what this term means is uncertain. It is proposed to retain the term “water availability”, generalised as described in bullet 4 above, in addition to the term “water quantity” and see what emerges from the search.

There was also a suggestion that the principal reason for a change in water availability is a change in evaporation (including evapotranspiration). However, the search is intended to identify all mechanisms that might affect components of the water balance, including those that might speed up the flow of water (e.g. soil crusting) or slow it down (e.g. blocking drains).

Some suggestions were very specific e.g. the effects of particular crops. However, the primary question does not reflect this (although it would have been easier to approach a study that was limited in its approach in this way) and, as it is, the search refers to fairly general land use and land management interventions, within the constraints identified in the REA protocol.

The question of scale, raised by the Project Board, is also an interesting one. There is nothing in the search that explicitly specifies a scale: the search uses what the REA team consider to be the best, neutral, terms. It is recognised that land use and land management take place at the small scale, and perhaps have a local effect, but these effects may still be apparent or significant at a larger (catchment) scale. It will be interesting to see what the search reveals. Presumably, the separate literature search being undertaken in Task B (on developing a range of plausible future land use, land management and growing season changes) can focus on whichever scale is considered most appropriate at that stage of the project.

1.3 Structure of this report

After this introductory section, Section 2 describes application of the REA protocol and reports on progress to date. Section 3 describes the next steps and invites the Project Board to nominate additional articles for consideration. The list of articles for review at full text is presented in Appendix 1.

2. Progress to date

2.1 Search strategy

The REA protocol defines a search strategy which aims to capture an unbiased and comprehensive sample of published literature relevant to the primary question within the timeframe of the REA. Articles identified by the search are managed using EndNote X6. The search is limited to the English language. No restrictions are applied regarding the year of publication or location (country).

2.2 Initial list of articles

To generate an initial list of articles, the online databases Scopus and Web of Knowledge (comprising Web of Science, BIOSIS and MEDLINE) were searched using the topic search strings in Table 2.1 (where * denotes a wildcard). Search terms within each group were combined using the Boolean OR operator, and between groups using the Boolean AND operator. The online database search identified 1192 articles. This list of articles is available on request, either as article authors and titles in an Excel spreadsheet, or as an EndNote X6 folder which also includes article abstracts.

Table 2.1: Search terms for online databases

Search string part 1	Search string part 2	Search string part 3	Search string p art 4	Search string part 5
water	runoff OR “river flow” OR streamflow OR “stream flow” OR discharge OR recharge OR “soil drainage” OR aquifer OR watertable OR “water table”	“*water availability” OR “availability of *water” OR “*water quantity” OR “quantity of *water” OR “*water resource* availability”	“land use” OR “land-use” OR landuse OR “land management" OR agricultur* OR “alien species” OR *forest* OR restor*	increas* OR decreas* OR chang* OR differen*

The websites of the following research and policy organisations were also searched, in addition to two web search engines, using the generalised search strings in Table 2.2, to address the limited ability of search engines to handle complex search strings:

- Centre for Ecology & Hydrology www.ceh.ac.uk
- British Geological Survey www.bgs.ac.uk
- Cranfield University www.cranfield.ac.uk
- defra www.defra.gov.uk
- Environment Agency www.environment-agency.gov.uk
- Envirobase www.envirobase.info

- www.google.co.uk
- http://scholar.google.co.uk

Only the first 10 hits from each website/web search were included, and no links were followed from the original hit. The website search thus identified 80 potential hits though several of these were later revealed to be duplicates of other hits, were duplicates of articles

already identified through the online database search, or were no longer working. This list of hits is available on request, as a list of web addresses in an Excel spreadsheet.

Table 2.2: Search terms for organisation websites and the internet

Search string part 1	Search string part 2
"land use" OR	"water availability" OR
"land-use" OR	"water quantity" OR
landuse OR	water AND runoff OR
"land management	groundwater AND recharge

2.3 Articles with relevant titles

The initial list totalling 1272 articles and hits was refined by applying exclusion criteria to the article titles or webpage titles and content to eliminate non-relevant articles. The exclusion criteria specify that the REA is:

- Not about water quality;
- Not about green water (rainwater or soil moisture directly used and evaporated by non-irrigated agriculture, pastures and forests) or grey water (return water or waste water);
- Not about urban or transport-related land use or land management;
- Not about natural or semi-natural changes or environment (e.g. wildfires, national parks) unless including some aspect of restoration;
- Not about non-freshwater (e.g. saline or brackish water);
- Not about multiple land use/management interventions;
- Not about water management (e.g. reservoirs, irrigation, drainage, abstractions, returns, etc);
- Not about changes in water availability as a direct result of climate change or climate variability;
- Not about modelling or future climate and/or land development scenarios;
- Not about structures (e.g. engineering works, pipes, hydraulics, etc);
- Not about domestic gardening or horticulture.

Two reviewers independently assessed all the article titles, applying the exclusion criteria. The level of agreement between the two reviewers, measured by statistical technique called kappa analysis, was 0.69 indicating substantial agreement. The discrepancies were discussed and resolved by consensus. 113 of the 1192 online database articles passed this stage, as did 12 articles from the 80 website hits. This list of articles is available on request as an EndNote X6 folder.

2.4 Articles with relevant abstracts

The list of 125 articles with relevant titles was refined by applying the exclusion criteria and some additional inclusion criteria (Table 2.3) to the article abstracts to eliminate non-relevant articles.

Table 2.3: Search inclusion criteria used in the REA

Criteria	Description
Population (subject)	Water available for human use i.e. surface water runoff or river/stream flow/discharge only, groundwater aquifer, recharge or water table only
Types of intervention	Any replicable land use or land management practice
Types of comparator	Evaluations using control sites or paired catchment studies: with/without, before/after, upstream /downstream
Outcome measure	Changes in water quantity only; quantifiable changes only
Type of study	Assessment of primary evidence of a change in water quantity caused by a land use or land management practice

Two reviewers independently assessed all the article abstracts, applying the exclusion and inclusion criteria. The reviewers disagreed on 31 of the 125 articles, corresponding to a kappa value of 0.48. The discrepancies were discussed with a third reviewer and resolved by consensus. 50 articles were assessed to have relevant abstracts; these articles are listed in Appendix 1 and are also available on request as an EndNote X6 folder.

Figure 2.1 summarises the search strategy and the number of articles at each stage of the process.

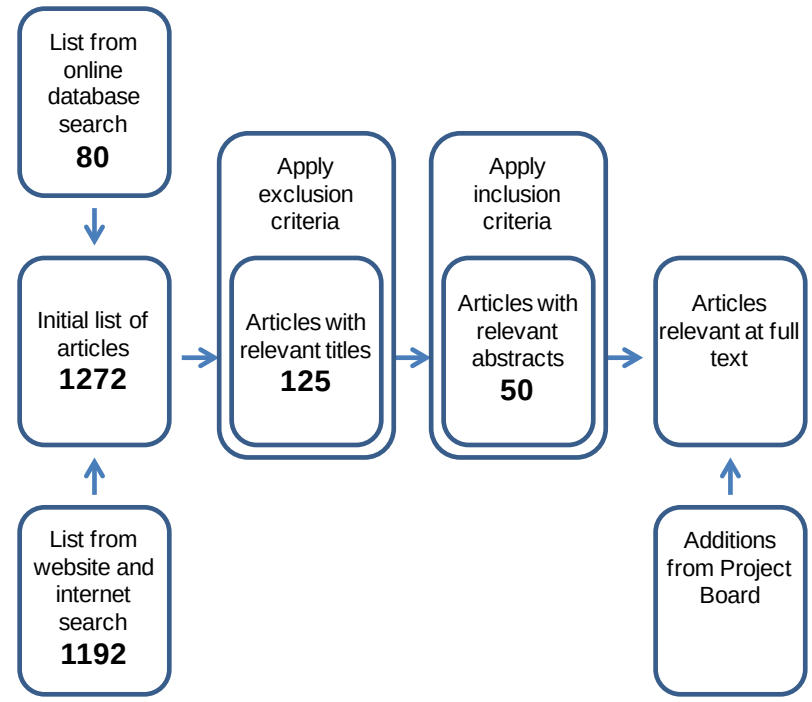

Figure 2.1: Process for refining the search

3. Next steps

3.1 Invitation to Project Board to nominate articles

There is now an opportunity for each Project Board member to put forward any additional articles considered relevant to the review – a maximum of three per Board member - such as grey literature or specialist papers not uncovered by the search strategy. This mechanism enables the Project Board members, each as an author, recognised expert and/or practitioner, to provide additional evidence in whatever aspect each considers most important, thus reflecting their individual perspective. These additional papers will enter the process at the final stage (Section 3.2). However, they must contain original evidence, not just assertion or opinion, or espouse best practice, without evidence. Similarly modelling studies that only explore simulated changes without supporting data cannot supply evidence. Evidence can only be included once: different papers referring to the same data, or repeating results from other papers, do not represent additional evidence. Please remember these points when nominating additional articles, which should be received by 21st June 2013.

3.2 Assessing the quality

The 50 articles which meet all the exclusion and inclusion criteria, plus any Project Board nominations, will next be viewed at full text. Articles will either be excluded because, upon examination of the full text, they do not in fact meet the inclusion criteria, or if they are assessed to have passed, articles will be processed by extracting data into a predefined spreadsheet template and assigning relevance and robustness weightings.

The relevance and robustness ratings will consider both the relevance of the article to the REA primary question and the quality of the methodological approach, which are critical to an objective and transparent assessment of the extracted evidence in the data synthesis. See Sections 3.5-3.7 of the REA protocol for more information.

Subject to time constraints, bibliographies of articles reaching this stage may be examined for any additional relevant references.

4. References

Houghton-Carr, H.A., Boorman, D.B and Heuser, K. 2013. Land use, climate change and water availability: Phase 2a. Development of the Rapid Evidence Assessment protocol. Centre for Ecology & Hydrology, Wallingford, UK.

Appendix 1 List of articles for review at full text

Aarts, H. F. M., B. Habekotte and H. van Keulen (2000). "Ground water recharge through optimized intensive dairy farms." Journal of Environmental Quality 29(3): 738-743.

Anuraga, T. S., L. Ruiz, M. S. M. Kumar, M. Sekhar and A. Leijnse (2006). "Estimating groundwater recharge using land use and soil data: A case study in South India." Agricultural Water Management 84(1-2): 65-76.

Burri, E. and M. Petitta (2004). "Agricultural changes affecting water availability: From abundance to scarcity (Fucino Plain, central Italy)." Irrigation and Drainage 53(3): 287-299.

Davis, E. A. (1993). "Chaparral control in mosaic pattern increased streamflow and mitigated nitrate loss in Arizona." Water Resources Bulletin 29(3): 391-399.

DeLaune, P. B. and J. W. Sij (2012). "Impact of tillage on runoff in long term no-till wheat systems." Soil & Tillage Research 124: 32-35.

dos Santos, E. H. M., N. P. Griebeler and L. F. C. de Oliveira (2010). "Relationship between land use and hydrological behavior in the 'Ribeirao Joao Leite' watershed." Revista Brasileira De Engenharia Agricola E Ambiental 14(8): 826-834.

Dung, B. X., T. Gomi, S. Miyata, R. C. Sidle, K. Kosugi and Y. Onda (2012). "Runoff responses to forest thinning at plot and catchment scales in a headwater catchment draining Japanese cypress forest." Journal of Hydrology 444: 51-62.

Ellison, D., M. N. Futter and K. Bishop (2012). "On the forest cover-water yield debate: from demand- to supply-side thinking." Global Change Biology 18(3): 806-820.

Engel, V., E. G. Jobbágy, M. Stieglitz, M. Williams and R. B. Jackson (2005). "Hydrological consequences of Eucalyptus afforestation in the Argentine Pampas." Water Resources Research 41(10): W10409-10401-W10409-10414.

Fernandez, C., J. A. Vega, J. M. Gras and T. Fonturbel (2006). "Changes in water yield after a sequence of perturbations and forest management practices in an Eucalyptus globulus Labill. watershed in Northern Spain." Forest Ecology and Management 234(1-3): 275-281.

Finch, J. (2004). "The hydrological impacts of energy crop production in the UK."

Giertz, S., B. Junge and B. Diekkruger (2005). "Assessing the effects of land use change on soil physical properties and hydrological processes in the sub-humid tropical environment of West Africa." Physics and Chemistry of the Earth 30(8-10): 485-496.

Gregory, M. M., K. L. Shea and E. B. Bakko (2005). "Comparing agroecosystems: Effects of cropping and tillage patterns on soil, water, energy use and productivity." Renewable Agriculture and Food Systems 20(2): 81-90.

Holman, I. P. (2002). "Investigating the effects of land drainage activities on natural recharge to groundwater."

Hu, Q., G. D. Willson, X. Chen and A. Akyuz (2005). "Effects of climate and landcover change on stream discharge in the Ozark Highlands, USA." Environmental Modeling & Assessment 10(1): 9-19.

Huang, T., Z. Pang and W. M. Edmunds (2013). "Soil profile evolution following land-use change: implications for groundwater quantity and quality." Hydrological Processes 27(8): 1238-1252.

Huber, A., A. Iroume, C. Mohr and C. Frene (2010). "Effect of Pinus radiata and Eucalyptus globulus plantations on water resource in the Coastal Range of Biobio region, Chile." Bosque 31(3): 219-230.

Islam, N., W. W. Wallender, J. Mitchell, S. Wicks and R. E. Howitt (2006). "A comprehensive experimental study with mathematical modeling to investigate the affects of cropping practices on water balance variables." Agricultural Water Management 82(1-2): 129-147.

Keil, A., A. Kleinhans, S. Schwarze, R. Birner, G. Gerold and S. Lipu (2003). "Forest conversion, water availability and water use in Central Sulawesi, Indonesia." Waldkonversion, Wasserverfügbarkeit und Wassernutzung in Zentral-Sulawesi, Indonesien 134(4): 411-427.

Leblanc, M. J., G. Favreau, S. Massuel, S. O. Tweed, M. Loireau and B. Cappelaere (2008). "Land clearance and hydrological change in the Sahel: SW Niger." Global and Planetary Change 61(3-4): 135-150.

Lorz, C., F. Makeschin, M. Strauch, F. H. Frimmel, G. Abbt-Braun, N. Hebben, K. Neder, F. Bakker, H. Weiß, P. Borges, A. Gaffron, R. Höfer, E. Worch, H. Börnick, H. L. Roig, D. Walde and J. Wummel (2011). "Importance of land use changes for an integrated water resource management - a case study from western central Brazil." Die bedeutung von landnutzungsänderungen für ein integriertes wasserressourcen-management eine fallstudie aus dem westlichen zentral-brasilien wasserversorgung, brasilien, iwrm, landnutzungswandel, talsperren, wasserqualität 152(9): 828-837.

Lozano-García, B., L. Parras-Alcántara and M. del Toro Carrillo de Albornoz (2011). "Effects of oil mill wastes on surface soil properties, runoff and soil losses in traditional olive groves in southern Spain." Catena 85(3): 187-193.

Mansur, S. and Y. Nurkamil (2010). "Oasis land use change and its hydrological response to Tarim River Basin." Geographical Research 29(12): 2251-2260.

Martínez, F., M. A. Casermeiro, D. Morales, G. Cuevas and I. Walter (2003). "Effects on run-off water quantity and quality of urban organic wastes applied in a degraded semi-arid ecosystem." Science of the Total Environment 305(1-3): 13-21.

Morán-Tejeda, E., A. Ceballos-Barbancho, J. M. Llorente-Pinto and J. I. López-Moreno (2012). "Land-cover changes and recent hydrological evolution in the Duero Basin (Spain)." Regional Environmental Change 12(1): 17-33.

Narain, P., R. K. Singh, N. S. Sindhwal and P. Joshie (1998). "Water balance and water use efficiency of different land uses in western Himalayan valley region." Agricultural Water Management 37(3): 225-240.

Nejadhashemi, A. P., C. Shen, B. J. Wardynski and P. S. Mantha (2010). Evaluating the impacts of land use changes on hydrologic responses in the agricultural regions of Michigan and Wisconsin, Pittsburgh, PA.

Nippgen, F., B. L. McGlynn, L. A. Marshall and R. E. Emanuel (2011). "Landscape structure and climate influences on hydrologic response." Water Resources Research 47.

Otero, I., M. Boada, A. Badia, E. Pla, J. Vayreda, S. Sabate, C. A. Gracia and J. Penuelas (2011). "Loss of water availability and stream biodiversity under land abandonment and climate change in a Mediterranean catchment (Olzinelles, NE Spain)." Land Use Policy 28(1): 207-218.

Piao, S., P. Friedlingstein, P. Ciais, N. de Noblet-Ducoudre, D. Labat and S. Zaehle (2007). "Changes in climate and land use have a larger direct impact than rising CO2 on global river runoff trends." Proceedings of the National Academy of Sciences of the United States of America 104(39): 15242-15247.

Prevost, M., A. P. Plamondon and P. Belleau (1999). "Effects of drainage of a forested peatland on water quality and quantity." Journal of Hydrology 214(1-4): 130-143.

Qiu, G. Y., J. Yin and S. Geng (2012). "Impact of Climate and Land-Use Changes on Water Security for Agriculture in Northern China." Journal of Integrative Agriculture 11(1): 144-150.

Ruprecht, J. K. and N. J. Schofield (1991). "Effects of partial deforestation on hydrology and salinity in high salt storage landscapes. I. Extensive block clearing." Journal of Hydrology 129(1-4): 19-38.

Scanlon, B. R., I. Jolly, M. Sophocleous and L. Zhang (2007). "Global impacts of conversions from natural to agricultural ecosystems on water resources: Quantity versus quality." Water Resources Research 43(3).

Scanlon, B. R., R. C. Reedy, D. A. Stonestrom, D. E. Prudic and K. F. Dennehy (2005). "Impact of land use and land cover change on groundwater recharge and quality in the southwestern US." Global Change Biology 11(10): 1577-1593.

Scott, D. F. and F. W. Prinsloo (2008). "Longer-term effects of pine and eucalypt plantations on streamflow." Water Resources Research 44.

Sharda, V. N., P. Samraj, S. Chinnamani and V. Lakshmanan (1988). "Hydrological behaviour of the Nilgiri sub-watersheds as affected by bluegum plantations, part II. Monthly water balances at different rainfall and runoff probabilities." Journal of Hydrology 103(3-4): 347-355.

Sikka, A. K., J. S. Samra, V. N. Sharda, P. Samraj and V. Lakshmanan (2003). "Low flow and high flow responses to converting natural grassland into bluegum (Eucalyptus globulus) in Nilgiris watersheds of South India." Journal of Hydrology 270(1-2): 12-26.

Smith, H. H. (1985). "Land use, runoff and recharge in selected watersheds in the US Virgin Islands."

Stewart, M. K. and B. D. Fahey (2010). "Runoff generating processes in adjacent tussock grassland and pine plantation catchments as indicated by mean transit time estimation using tritium." Hydrology and Earth System Sciences 14(6): 1021-1032.

Stone, K. C., P. G. Hunt, K. B. Cantrell and K. S. Ro (2010). "The potential impacts of biomass feedstock production on water resource availability." Bioresource Technology 101(6): 2014-2025.

Strebel, O. and M. Renger (1977). "The influence of vegetation and soil differences on evapo transpiration and deep seepage." Berichte ueber Landwirtschaft 55(4): 646-651.

Temesgen, M., H. H. G. Savenije, J. Rockström and W. B. Hoogmoed (2012). "Assessment of strip tillage systems for maize production in semi-arid Ethiopia: Effects on grain yield, water balance and water productivity." Physics and Chemistry of the Earth 47-48: 156-165.

Tsai, Y. and R. M. Vogel (2010). Climatic and anthropogenic influences on freshwater availability in the eastern United States, Providence, RI.

van Dijk, A. I. J. M., P. B. Hairsine, J. P. Arancibia and T. I. Dowling (2007). "Reforestation, water availability and stream salinity: A multi-scale analysis in the Murray-Darling Basin, Australia." Forest Ecology and Management 251(1-2): 94-109.

Walker, G. R., I. D. Jolly and P. G. Cook (1991). "A New Chloride Leaching Approach to the Estimation of Diffuse Recharge Following a Change in Land-Use." Journal of Hydrology 128(1-4): 49-67.

Whitehead, P. G. and M. Robinson (1993). "Experimental basin studies - an international and historical-perspective of forest impacts." Journal of Hydrology 145(3-4): 217-230.

Yang, D., W. Shao, P. J. F. Yeh, H. Yang, S. Kanae and T. Oki (2009). "Impact of vegetation coverage on regional water balance in the nonhumid regions of China." Water Resources Research 45.

Yoshida, T., T. Masumoto and N. Horikawa (2012). "Changes in Rainfall-Runoff Characteristics of Small Watersheds due to Cultivation Conditions of Hilly Paddies." Transactions of the Japanese Society of Irrigation Drainage and Rural Engineering 80(2): 39-46.

Zhan, C., Z. Xu, A. Ye and H. Su (2011). "LUCC and its impact on run-off yield in the Bai River catchment-upstream of the Miyun Reservoir basin." Journal of Plant Ecology 4(1-2): 61-66.