

Software tool helps develop and protect botanical resources

RIU

Validated RNRRS Output.

The Botanical Research and Herbarium Management System (BRAHMS) is a novel software tool that captures plant and biodiversity data and images from herbarium specimens, literature, field observations, and plot samples. It then converts them into products and publications that help in the development and protection of botanical resources. It also facilitates the exchange of data among people, institutions and countries. BRAHMS is currently used in more than 29 countries worldwide, and is freely available from the website www.brahmsonline.com. The products of the BRAHMS system can help countries understand the resources they possess, and how to harness them for agriculture, forestry, and medicinal and conservation purposes. They can also empower local communities and research institutes through training and the provision of information.

Project Ref: **FRP08:**

Topic: **7. Spreading the Word: Knowledge Management & Dissemination**

Lead Organisation: **University of Oxford, UK**

Source: **Forestry Research Programme**

Document Contents:

[Description](#), [Validation](#), [Current Situation](#), [Current Promotion](#), [Impacts On Poverty](#), [Environmental Impact](#),

Description

Research into Use

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Geographical regions included:

[Africa](#), [Asia](#), [Central America](#), [Europe](#), [North America](#), [South America](#),

Target Audiences for this content:

[Forest-dependent poor](#),

FRP08**A. Description of the research output(s)****1. Working title of output or cluster of outputs.**

In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

development and implementation of the brahms and brahms online database systems (R7276)

Alternative title:

capturing botanical knowledge – building foundations for a sustainable and biodiverse future.

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Forestry Research Programme

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

The BRAHMS Project was initiated and largely developed with support from the DFID [Forestry Research Programme \(FRP\)](#). Database work in general started in 1985 under ODA Research Scheme **R3881** 1984 -1987 (*The Development of Breeding Populations and Genetic Improvement Strategies for Tropical Pines*). Database work during that project started on seed lot and provenance trial management, this work leading to development of the SISTEM database (Species Information Seed, Trial and Environment data Management) as described in 'Filer,D.L., *A Database for Tree Improvement and Seed Bank Management, Commonwealth Forestry Review* 67 (3) No 212. 1988'.

Database development was continued under **R4369** 1987- 1989 (*Expansion and Integration of the Oxford Forestry Institute Tropical Forest Resources Database*). In the summary of the final report for R4369 is found the text "A microcomputer version of the herbarium database known as BRAHMS (Botanical Research And Herbarium Management System) is currently being prepared. By distributing this database to research collaborators and key herbaria, it will be possible to coordinate and standardize the collection of fundamental botanical information on species of interest with significant implications for basic tree improvement research and taxonomy in general".

In the same report, section 2.4 can be found "Funds for the development have been made available through the ODA/OFI Manpower Centre Scheme in collaboration with the ODA Forestry project in Honduras and through the ODA R&D project R4526 (the study and acquisition of genetic resources of *Acacia karroo*)".

Work was continued under FRP **R7276** August 1998 - March 1999 (*Distribution of monographic data-sets of*

Calliandra, Inga, Leucaena, Parkinsonia, and Pinus in electronic format – a model for future dissemination of botanical data). During 2004, a 6 month extension was allotted by FRP (**R7276E** 1 March 2004 to 31 August 2004) to promote the publication of BRAHMS databases on the internet using BRAHMS online.

An extension to **R7276** made a further contribution, in particular, helping to distribute valuable botanical information via the newly developed BRAHMS online service. A final and further extension to **R7276** provided funding to develop a comprehensive help system for BRAHMS including training exercises.

4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? (max. 400 words). This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.

DFID target countries tend to be seriously under-resourced in the various tiers of research institute that manage and provide information about their biological resources. Yet, it is well understood that the management and understanding of these resources plays a key role in development.

It is the case that a) many DFID target countries have a complex kaleidoscope richness of biodiversity; b) remarkably little is properly understood about this diversity; c) much of this **diversity is threatened by accelerated development**; and d) there is huge potential to further **harness and develop these resources for agriculture, forestry, medicinal and conservation purposes**.

There is thus a pressing need to build capacity in this area, **empowering local communities** and **government research institutes**, through training and the provision of information, to have greater understanding of and control over their natural **biological resources** leading towards **poverty reduction**.

The principal output of this research cluster is **BRAHMS – Botanical Research And Herbarium Management System**. Although essentially a software tool, BRAHMS embodies a set of procedures to **capture plant and biodiversity data and images** from a wide range of sources (e.g. herbarium specimen, literature, field observations, plot samples) and to distil these data into **products and publications** that contribute to the **development and protection of botanical resources**. It also encourages and **facilitates the exchange of botanical data** between people, institutions and countries. BRAHMS also includes a module for **managing seed and gene banks**, proving close links between seed collections and botanical vouchers.

BRAHMS internet services enables herbarium curation systems, monographs, checklists and other species reports to be published on the internet individually or in database groups, enabling all BRAHMS users to publish their databases online. Via this service, data can also be submitted to larger global services including GBIF. As well as optimizing the dissemination of all BRAHMS related species and specimen data, the online service has been developed to assist with curation activities including streamlining the exchange of specimens and helping to update the identification of specimens by cross-referencing with duplicated collections.

The FRP funded **BRAHMS help system** brings together all technical information about BRAHMS and provides modular training exercises facilitating sustainable database development.

5. What is the type of output(s) being described here?**Please tick one or more of the following options.**

Product	Technology	Service	Process or Methodology	Policy	Other Please specify
X	X	X			

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

BRAHMS works with all plant species thus covering agricultural crops, trees grown for timber and paper production as well as multipurpose trees. Within current funding constraints, it would be inappropriate to extend BRAHMS to document other groups of living organisms although extension to living collections is current being considered.

7. What production system(s) does/could the output(s) focus upon?**Please tick one or more of the following options.***Leave blank if not applicable*

Semi-Arid	High potential	Hillsides	Forest-Agriculture	Peri-urban	Land water	Tropical moist forest	Cross-cutting
X	X	X	X			X	X

8. What farming system(s) does the output(s) focus upon?**Please tick one or more of the following options (see Annex B for definitions).***Leave blank if not applicable*

Smallholder rainfed humid	Irrigated	Wetland rice based	Smallholder rainfed highland	Smallholder rainfed dry/cold	Dualistic	Coastal artisanal fishing
X						

9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNNRS and non RNNRS)? (max. 300 words).**Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNNRS outputs for which proformas are currently being prepared.**

On the one hand, there are already technical links between BRAHMS and specific FRP projects. The system has been used to document all African *Acacia* species data and maps (R6550); support work on *Leucaena*, *Pinus* in Latin America and feed data into the Virtual Field Herbarium (VFH). There are also ongoing links to various projects established through DFID bilateral support, good examples being the network on BRAHMS databases in Amazonian Brazil and ongoing data capture at the East African Herbarium in Kenya.

As noted in sections 19 and 22, there is scope to foster and strengthen links between the scientific and agricultural sectors with an initial focus on some countries in Africa. R8484 (Good Seed Initiative) may be a potential target.

There is considerable scope to further integrate BRAHMS with the Virtual Field Herbarium, field guide production in general, the provision of botanical data online and the management of seed and gene banks.

The natural relationships that have been formed between BRAHMS, the VFH, the *Acacia* project, the Field Guides project combined with a strong Africa focus of the Oxford University Herbaria and very close project links in countries like Ghana, Kenya, Tanzania and Malawi – and the clear mandate to focus inputs on these countries - would favour a clustering of the Oxford related researchers to develop an orchestrated research programme to document and publish information on African botanical resources.

Validation

B. Validation of the research output(s)

10. How were the output(s) validated and who validated them?

Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the “who” component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation (max. 500 words).

The BRAHMS system is continually being evaluated informally by users and the feedback they provide and the BRAHMS Project continuously solicits critical comment so that the overall system can be improved. Problems, limitations and requests for improved functionality are received by email. The development of the entire system is fully demand driven.

The best quantitative measures of uptake and usefulness are a) website registrations b) successful (=sustainable) project implementation and c) reports, publications and/or analyses derived from BRAHMS. Training courses are formally evaluated using by questionnaire.

Especially close consultation is maintained with the BRAHMS Advisory Group who provide recommendations on overall development strategy and direction. The Advisory group (<http://herbaria.plants.ox.ac.uk/BOL/home/committee.aspx>) currently consists of 13 scientists and system users.

We did try a formal survey of user during 2000 but response was rather poor. However, one clear result of this

survey was the need to provide improved documentation (although frankly, I think we already knew this).

11. Where and when have the output(s) been validated?

Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above (max 300 words).

Feedback about BRAHMS is continuous and comes from all countries where the system is currently in use. However, perhaps the best temporal and geo-specific validation comes through in-country training courses as these provide intimate interaction with many users simultaneously.

For example, a one week BRAHMS training course was held at the East African Herbarium, Kenya late 2005 with participants from Ghana, Kenya, Tanzania and Portugal attending. Five courses have been run in Brazil Amazon region during 2006 and a one week in Kepong, Malaysia course was given in July 2006 to 40 botanists from East and West Malaysia, China and Indonesia. Thus, it could be said that specific validation was held in Kenya, Brazil and Malaysia during 2005/2006.

Current Situation

C. Current situation

12. How and by whom are the outputs currently being used? Please give a brief description (max. 250 words).

BRAHMS is in active use more or less globally - digitizing species and collection data, curating herbaria, catalyzing botanical research initiatives, underpinning conservation decision-making and facilitating the publication of floras, species checklists and monographic accounts. The list below is a representative selection of projects covering each of these areas. The entries below are hyperlinked to brief project descriptions.

- [Brazil training courses 2006](#) : Database training events in Brazil during the first half of 2006.
- [Conifer database](#) : one database - three key publications.
- [East African Herbarium \(EA\) and API](#) : the EA herbarium in Kenya hosted an international training course for the African Plants Initiative (API) project in November 2005.
- [Embrapa Amazonia Oriental](#) : the Herbario IAN in Belem, Brazil, one of the three principal Brazil Amazonian herbaria, 100% databased and imaged.
- [Gabon database](#) : storing data from 95% of all plant specimens known to have been collected in Gabon and leading to the publication of Checklist of Gabonese Vascular Plants.
- [Kepong Herbarium Malaysia](#) : a key curation database for South East Asia.
- [Leucaena monograph](#) : the Leucaena database can be downloaded in full and is used to provide examples in the BRAHMS training exercises.
- [MAPR Herbarium](#) : located in Mayaguez, Puerto Rico, the longest running BRAHMS project in the Caribbean

region to date.

- [National Herbarium of the Netherlands](#) : the Leiden, Utrecht and Wageningen herbaria, currently being merged into a single herbarium database resource for the Netherlands.
- [Oxford University Herbaria](#): hosting an exciting range of database projects and home of BRAHMS development.
- [PBI Solanum](#) : databasing one of the largest angiosperm genera. A Planetary Biodiversity Inventory project.
- [Pulong Tau National Park](#) : a sample checklist project from Sarawak, Borneo.
- [Revision of Pternopetalum](#) : Pternopetalum Franchet (Apiaceae) is one of the largest genera of Apiaceae in Asia.

13. Where are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used (max. 250 words).

BRAHMS is used by projects in Africa, Europe, the Middle East, North, the Americas and Asia. As of December 2006, BRAHMS has projects in research departments and herbaria in Europe (Baltic states, Germany, France, Netherlands, Portugal and the UK); Africa (Benin, Cameroon, Gabon, Ghana, Kenya, Malawi, Tanzania); Middle East/Asia (Bangladesh, Indonesia, Kuwait, Malaya, Philippines, Sabah, Sarawak, Singapore, Thailand) and the Americas (Bolivia, Brazil, Colombia, Honduras, Panama, Puerto Rico, USA).

The first project outside the University of Oxford was started at the Paul C. Standley herbarium (EAP), Honduras in 1989. The largest databases to date are in the Netherlands where the Leiden, Utrecht and Wageningen databases have been growing since about 1995. One offshoot of this latter project is the Types of the Netherlands web site which includes c.40,000 images online. Regional database networks are being established in Amazonian Brazil, the Netherlands and South East Asia.

It is worth stressing at this point that the use of BRAHMS in developed countries such The Netherlands plays a critical role in developing the botanical resources in developing countries. For example, Wageningen provides comprehensive botanical support to countries in West Africa ad Leiden to countries in South East Asia including Indonesia.

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading (max 250 words).

BRAHMS is currently one of the most widely used herbarium management/botanical data capture tools. The BRAHMS Project maintains a document summarizing all known projects. The system is freely available on the BRAHMS website www.brahmsonline.com. Download frequency varies and peaks after a new Version is published each 4 - 6 months.

Uptake increased and the quality of BRAHMS use improved following the publication of the FRP funded documentation system published in 2005.

Use is still spreading and the current round of system upgrading, funds permitted, to include a) Living Collections b) Plot samples, c) Field observations of species occurrence and d) an expansion of the seed and gene bank

management module is likely to broaden uptake.

As of late 2006, new projects are starting in China, Tanzania and Indonesia. We are currently transferring the data gathered in the long running PROSEA project (Plant Resources of South East Asia) into BRAHMS – this also having potential to link into the FRP funded Virtual Field Herbarium (VFH).

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? (max 350 words).

a) DFID's bilateral research programmes in Kenya and Brazil were effective stimulating uptake in those countries.

b) The Darwin Initiative (DI) projects have been in part encouraged uptake as several DI projects use or have made use of BRAHMS (although the BRAHMS Project itself has failed to raise funds directly from DI).

c) Demand to document biological resources in general (e.g. Convention on Global Biodiversity, environmental pressure groups) has tended to raise awareness of the need to catalogue collections.

d) Specific projects such as:

a) the Melon Foundation African Plants Initiative (API) see e.g. <http://www.sanbi.org/research/api.htm> has promoted herbarium based activity in Africa – some of these make use of BRAHMS.

b) The Brazil government's PPBio initiative (Programa de Pesquisa em Biodiversidade) – see <http://ppbio.inpa.gov.br/Eng/just/> which has demanded the dissemination of biological collections data and this in turn has led to a unification of the main Brazil Amazon herbarium BRAHMS databases and the sanctioning of these data being published online.

c) The Kew Millennium Seed Bank project (see <http://www.kew.org/msbp/>) has adopted BRAHMS for capturing data on endangered and economically important species and is using BRAHMS to produce a series of seed collection guides for 15 countries.

Current Promotion

D. Current promotion/uptake pathways

16. Where is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion (max 200 words).

Promotion takes place in the following ways:

a) Main BRAHMS website on www.brahmsonline.com. Search engines have indexed this site and thus, BRAHMS is promoted with the relevant keyword searches. This level of promotion is global. Cross

referencing on other websites (e.g. GBIF on <http://www.gbif.org/>).

- b) Regional training courses promote BRAHMS uptake. During 2006, 1 week courses were held in Bolivia (1 course, 10 trainees); Malaysia (1 course, 40 trainees); Indonesia (2 days, 5 trainees); Brazil (5 courses c.120 trainees).
- c) Meetings, conferences, symposia, invited contributions. For example, invited contribution to present BRAHMS online in Manaus, Amazonian Brazil in July 2006.
- d) Overseas staff and students visiting European herbaria. For example, botanists from Tanzania visiting Kew under the Millennium Seed Bank enhancement project, working with BRAHMS; similarly, botanists from Gabon visiting Wageningen Herbarium, Netherlands.
- e) Word of mouth and successful projects and notable publications.

17. What are the current barriers preventing or slowing the adoption of the output(s)? Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. (max 200 words).

Smaller herbaria and many researchers in developing countries often lack resources, computing confidence and institutional support – although recently (during the last 2-3 years), this situation has improved and continues to improve as has internet access to download software and useful data resources.

Institutional (or sometimes national) restrictions can obstruct data dissemination and/or exchange – this being a key objective of the BRAHMS Project. In some cases, institutional difficulties can lead to limited funds being siphoned off basic herbarium work into Administration.

The BRAHMS Project runs on an extremely tight budget and operates within these restrictions. Failure (to date) to secure a Darwin Initiative grant (3 times) is somewhat indicative of a more general problem where, understandably, funding agencies (FRP notably an exception) are keener to fund specific projects that may use BRAHMS than the strategic development of BRAHMS itself. Perhaps relevant to point out that compared to the massive EU and GBIF level budgets, relatively, we operate on a very cost-efficient basis.

18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues (max 200 words).

Gradual improvement to BRAHMS system and related documentation – focusing on a) simplification of use b) continuously improved documentation and c) flexibility of outputs.

Modest funding to support some development and regional training courses would be very useful.

Closer integration of BRAHMS with the Virtual Field Herbarium would provide a potentially huge incentive to many projects to further document their collections and coordinate and organize vast numbers of plant images.

19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor

people? (max 300 words).

Providing a steady and reliable service for managing botanical resources that caters for the broadest range of needs and abilities has been important. Ensuring this service always available and that it is easy to use and has very accessible documentation. Encouraging projects not only to capture botanical data (within their limited budgets) but to promote and publish these data in readily usable formats. In this context, providing guidelines as to how the vast quantities of raw botanical data that reside in herbaria can be distilled into different categories of useful outputs including those with conservation implications. Thus, in many ways, our challenge as a project is to encourage and well as facilitate these processes.

Essential to provide adequate support to herbaria in developing countries where the needs are greatest. Best to establish one in-country centre of excellence for this and to establish this as a regional centre for training.

Establishment of BRAHMS projects in countries with good or even excellent resources, for example UK, Malaysia, Singapore and the USA. Projects in these countries, almost without exception, are of benefit to less developed countries. They in turn provide training for visitors from developing countries; they provide many services including plant identification; and their botanical collections are distributed in duplicate to smaller herbaria where the collections originated.

Fostering links between the scientific and agricultural sectors is important – as described at the end of Section 22.

Impacts On Poverty

E. Impacts on poverty to date

20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.

To my knowledge, no such studies have taken place.

21. Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) (max. 500 words):

- **What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;**
- **For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;**

- **Indicate the number of people who have realised a positive impact on their livelihood;**
- **Using whatever appropriate indicator was used detail what was the average percentage increase recorded**

N/A

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? (max 300 words)

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

DFID target countries are often seriously under-resourced in the various tiers of research institute that provide information about their biological resources, including plant species. It is the case that such countries often have a complex kaleidoscope richness of biodiversity and that this is often seriously threatened by accelerated economic development.

Herbaria work at the lowest level of botanical knowledge, helping to know the differences between one species and other and to be able to gather together facts about species and put this into the correct 'box'. Without good species naming, which in turn has to be linked to the physical plant specimens stored in herbaria, confusion arises and it is very difficult to make reliable statements about individual plants and species. This in turn confuses ecological statements and all categories of biodiversity and conservation study.

Development and conservation of natural resources go hand in hand. To provide meaningful conservation support, improvement is needed in two principal areas: reliability of species identification and knowledge of species' distributions. This must be combined with greater dissemination and use of the relevant data. The ultimate source of these data resides with decades of botanical collections held in the regional herbaria. However, the inaccuracy of the identifications, and the lack of quality control of the data-set they represent, can hinder rather than assist with biodiversity assessment and conservation judgments.

There is thus a real need to build capacity in this area, empowering local communities and government research institutes, through training and the provision of information, to have greater understanding of and control over their natural biological resources.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? (max 100 words)

No adverse environmental impacts recorded. When publishing BRAHMS data online, information on rare species is restricted.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? (max 200 words)

Many natural disasters (including the affect of climate change) have a direct link to knowledge of the properties of plant species as provided by BRAHMS. Numerous plant species exist within narrowly defined environment bands. Even now, changes in species distribution patterns due to climate change are being detected (e.g. altitude ranges moving upward). Crop production patterns are likely to change.

For example, in the Philippines, flash floods and coral silting are best prevented by maintaining forest cover. However, given that the country is so seriously denuded of forest cover, the next best strategy will depend on a knowledge of local plant species. How, when and where to plant which species is information that ultimately will come from the botanical research community. Another example is in Amazonian Brazil where improved knowledge of tree species will contribute to improving forest logging controls, protecting rarer species and optimizing forest regeneration.
