NATURAL RESOURCES SYSTEMS PROGRAMME

PROJECT REPORT[1]

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Decision support tools (LEXSYS and LEGINC).
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LEXSYS: DECISION SUPPORT FOR THE SELECTION OF LEGUMES FOR INCORPORATION INTO TROPICAL CROPPING SYSTEMS

LEXSYS was conceived and developed by the International Institute of Tropical Agriculture with NARS and IARC collaborators in West and Central Africa interested in integrating legumes into farming systems. The computerised database contains information on 113 tropical herbaceous and shrub legume species and a small number of woody legumes and tropical crops. The criteria used to search the database are; ecological adaptability, cropping system niche, contributions to farming systems and pest problems. These criteria are grouped under 28 headings (Table 1) that allow the user to be more or less restrictive in the choice of legumes from the database.

Table 1: Selection criteria for LEXSYS

Ecological adaptability	***System Niche***	***Contributions***	***Pest Problem (Species not susceptible to…….)***	***Trap Crops for….***
Precipitation	Morphology	Vegetable (human nutrition)	Diseases	Parasites
Altitude	Growth type	Grain yield	Insect pests	Nematodes
Temperature	Life cycle	Green fodder yield	Viruses	
pH range	Initial growth rate	Hay yield	Nematodes	
Drought tolerance	Productive growth rate	Soil nitrogen contribution	Parasitic weeds	
Fertility requirement		Potential to control soil erosion		
Soil type		Weed suppression potential		
Water-logging tolerance		Avoid toxicity in grain/green fodder		

The first version of LEXSYS was released in 1993-94 and has been subjected to several iterations to develop further versions. The latest version has been created using 'LPA Prolog' by the University of Wales, Bangor, UK. This version has a more user-friendly interface than previous versions, and the user can browse the database tables via a pop-up dialogue. This version can also browse other database applications so that other decision support applications can make use of the LEXSYS selection as part of the decision making process. Further development is taking place to include information on source of seeds; contact addresses of informants; photos of plants and seeds; any additional information to add to the species reports, e.g. length of vegetative cycle; information/data from trials and practices incorporating legumes into cropping systems – particularly from geographic areas outside West and Central Africa. We are soliciting contributions of this nature which can be sent to lexsys@bangor.ac.uk; copies of LEXSYS are also available from this address.

LEGINC: INTEGRATION OF COVER CROPS INTO CROPPING PATTERNS IN GHANA

This is a decision support tool for integrating legumes into cropping patterns based on data from Ghana. The tool asks a series of questions for the user to respond to. A list of legume species with potential for the required purposes is then produced and revised according to the responses given. A suitable way (or ways) of integrating one of these legumes into cropping patterns is also suggested. A detailed information sheet is produced as an example of how one of these legumes has been integrated into a cropping pattern in Ghana (included in this annex as PDF files). Where they are available pictures of the legumes and their seeds are also produced.

So far four main areas are (fully or partially) covered by the decision support tool:

1. *Integration of the legume into an ecological system niche in the existing cropping pattern*
   So far the decision support tool has been designed to identify suitable legume species for growing in association with cocoa, plantain, maize and vegetables. There is also the option for a long or short duration planted fallow. Data on legume life cycle, shade tolerance, growth type, growth rate and persistence have been extracted from LEXSYS. This is combined with information about cropping patterns in southern Ghana obtained through participatory fieldwork with farmers on improved fallows and lessons learned about legume performance under the ecological conditions of southern Ghana from previous legume trials. In addition to identifying an appropriate ecological niche the decision tool also attempts to identify other constraints that could limit the niche available to a legume. These include considerations of land access and dry season bush fires.

2. *Matching the legume to desired products or services*
   The user selects the desired products or services of the legume which include edible grain, green fodder, nematode control, weed suppression and soil nitrogen. These are again matched to legume data from LEXSYS to suggest appropriate species. Other more crop specific legume functions are wind speed reduction and mulching for soil moisture conservation.

3. *Matching the legume to site conditions*
   Legume species are matched to site conditions using data from LEXSYS. Total annual rainfall is selected using a clickable map. Tolerance to water-logging is also identified as a potential constraint where legumes are grown in association with dry season vegetables.

4. *Matching management of the legume to farmers' labour and management constraints*
   Farm labour and management are important constraints in sub-Saharan Africa that have a large influence on crop productivity. Where possible legume choices are limited to those that are less labour and management demanding. On some decision paths the user is able to restrict legume species to those which require less labour to establish, or to maintain due to their planting and weeding requirements or type of growth. On others the user is asked to choose when labour is available to plant and weed the legume.

In addition to a list of potential legume species, detailed information sheets are an output of the decision process (Table 2). They are designed to be concise but provide as much useful practical information as possible. They include the following:

- Detailed instructions on how to grow the legume under Ghana specific conditions and integrate it with other chosen crops,
- Pictures of the legume and its seeds,
- The main characteristics of the legume species,
- The biophysical and socio-economic requirements for growing the legume,
- Information about utilisation of the legume such as grain processing for human consumption, and fodder and fuel wood potential.

Table 2: Information sheets available with LEGINC

Technology
Green manure e.g. *Mucuna* for vegetables
Long duration legume e.g. long duration *Mucuna*, to mulch a vegetable crop
Long duration legume for weed suppression on plantations e.g. *Pueraria phaseoloides*
Long planted fallow e.g. *Sesbania* or *Gliricidia*
Maize followed by a green manure e.g. *Mucuna*, for dry season vegetables
Major season fallow e.g. short duration *Mucuna*, followed by minor season maize
Major season maize followed by a minor season fallow e.g. short duration *Mucuna*
Major season maize followed by a minor season fallow e.g. short duration Mucuna, followed by dry season vegetables
Major season maize relayed with a fast growing cover crop e.g. long duration *Mucuna*, followed by dry season vegetables
Major season maize relayed with fast growing cover crop e.g. long duration *Mucuna*
Major season maize simultaneous or relay planted with a slow growing cover crop e.g. *Canavalia ensiformis*, followed by dry season vegetables
Major season maize simultaneous or relay planted with slow growing cover crop e.g. *Canavalia ensiformis*
Plantain and maize relayed with slow growing cover crop e.g. *Canavalia ensiformis*
Plantain intercropped with a creeping legume e.g. *Canavalia ensiformis* for weed suppression
Plantain intercropped with an erect legume e.g. *Flemingia macrophylla* for mulch
Short duration legume e.g. short duration *Mucuna*, to mulch a vegetable crop
Short duration major season legume e.g. short duration *Mucuna* to mulch a vegetable crop
Short planted fallow e.g. *Mucuna* or *Pueraria*

As with LEXSYS, we are soliciting comments on LEGINC, and how it can be further developed. Comments of this nature can be sent to leginc@bangor.ac.uk; copies of LEGINC are also available from this address. Final (demonstration) copies of LEXSYS and LEGINC were developed to incorporate stakeholder inputs at the dissemination workshop in October, 2002 and distributed February, 2003. The package was widely distributed (Table 3) for feedback.

Table 3: Dissemination list for LEGINC and LEXSYS

International

Person	**Organisation**	**Address**
Robert Carsky	International Institute of Tropical Agriculture, Benin	IITA Benin Research Station BP 08-0932, Cotonou, Benin
G Tarawali Shirley Tarawali	International Institute of Tropical Agriculture, Nigeria	IITA c/o Lambourn (UK) Limited, Carolyn House 26 Dingwall Rd., Croydon, CR9 3EE, England
Stephan Weise Stephan Hauser Christian Nolte (for onward dissemination within IITA)	International Institute of Tropical Agriculture, Cameroon	IITA Humid Forest Ecoregional Center (HFEC), Mbalmayo BP 2008 (Messa), Yaoundé Cameroon c/o Lambourn (UK) Limited, Carolyn House, 26 Dingwall Rd., Croydon, CR9 3EE, England
Roland Bunch	Association of Consultants for a Sustainable, Ecological and	COSECHA, Apartado 3586, Tegucigalpa, Honduras, Honduras

	People-centred Agriculture	
Carlos Perez	Programa para la Agricultura Sostenible en Laderas de América Central	PASOLAC- NICARAGUA Apartado Postal No. 6024, Managua, Nicaragua
Kurt Steiner	German Development Cooperation	GTZ Dpt. 106/45 P.O.Box 5180, 65726 Eschborn/Germany
David Jackson, Barry Pound, Elizabeth Kiff	Natural Resources Insitute	NRI University of Greenwich at Medway Central Avenue Chatham Maritime Chatham Kent ME4 4TB
	International Cover Crops Clearinghouse	CIDDICO P.O. Box 4443, Tegucigalpa MDC, Honduras
Daniel Buckles	International Development Research Centre	IDRC 250 Albert Street P.O. Box 8500 Ottawa, Canada
Richard Fowler	ACT NOW! African Conservation Tillage network	5 Musson Mews, Hayfields, Pietermaritzburg 3201, South Africa
Bernard Vanlauwe Catherine Gachengo	Tropical Soil Biology and Fertility Programme	TSBF c/o UNESCO ROSTA. PO Box 30592, Nairobi.
Georg Cadisch	Imperial College of Science, Technology and Medicine, Wye	Imperial College of Science, Technology and Medicine, Wye, Ashford, Kent TN25 5AH, UK
Georg Weber	Swiss Association for International Cooperation	SSSMP- Helvetas GPO Box 689 Kathmandu Nepal
Pratap Shrestha	Local Initiatives for Biodiversity, Research and Development	LIBIRD PO Box 324 Bastolathar Mahendrapool Pokhara Nepal

In Ghana:

Person	**Organisation**	**Address**
Patterson Osei-Bonsu James Asibuo	Crop Research Institute	CRI, PO Box 3785 Kumasi, Ghana
Joseph Kwasi Adu	Animal Research Institute	ARI P.O.Box AH 20, Achimota, Accra, Ghana.
Francis A. Tuor James Kombiok,	Savanna Agriculture	SARI, PO Box 52,

M. Fosu E Frey	Research Institute	Tamale, Ghana
Paye Drechsel O.O. Cofie	International Water Management Institute	IWMI, PMB CT 112 Cantoments Accra Ghana
K Ofori-Frimpong M R Appiah A A Afrifa Gilbert Anim-Kwapong	Cocoa Research Institute of Ghana	CRIG PO Box 8 New Tafo-Akim Ghana
Heinz Loos	Sedentary Farming Systems Project (SFSP)	SFSP, German Development Cooperation (GTZ) PO Box 473 Sunyani Ghana
S Agyenim-Boateng F M Tetteh J O Fening	Soil Research Institute	SRI Academy Post Office Kwadaso Kumasi Ghana
Sam Peprah Dr John A. Otoo	Crop Research Institute	CRI PO Box 3785 Kwadaso, Kumasi Ghana
J P Tetteh	University of Cape Coast	School of Agriculture, University of Cape Coast, Ghana
Charles Quansah	Kwame Nkrumah University of Science and Technology	Crops Science Department KNUST, Kumasi, Ghana
Dr S Oppong-Yeboah (Tano District Agric. Director) Mr Asante-Kroba (Wenchi DDA) Mr Asiedu (Atwima DDA) Felix Ofasi (Tano AEA) Philip Titriku (Regional Director of MOFA) Mr A.K. Owusu (Sunyani DDA)	Ministry of Food and Agriculture	MOFA, Box 138 Bechem, Tano district, Ghana MOFA, PO Box 100, Wenchi, Brong Ahafo, Ghana PO Box 148, Bechem, Brong Ahafo, Ghana PO Box 86, Sunyani, Brong Ahafo, Ghana MOFA District Office, P. O. Box 635, Sunyani
Olivia Agbenyega	Institute of Renewable Natural Resources	Dept. of Agroforestry, IRNR, University of Science & Technology, Kumasi, Ghana
	Ghana Organic Agriculture Network	GOAN, PO Box 6342, Kumasi, Ghana
Prof. E. Owusu-Bennoah Deputy Director General	Council for Scientific and Industrial Research (Agriculture,	CSIR PO Box M32, Accra, Ghana

	Fisheries & Forestry)	
Dr John Poku Deputy Director	Ministry of Food and Agriculture	MOFA, PO Box M37, Accra, Ghana
Joseph Cobbina	CSIR	CSIR, PO Box M32, Accra, Ghana

Africa:

Person	**Organisation**	**Address**
Vissoh, V. Pierre	SASAKAWA Global 2000,	SG 2000 BP 04-1091 Cadjehoun Cotonou, Benin
Albert Eteka	Center for Cover Crops Information and Seed Exchange in Africa	CEIPCA/ IITA Benin Research Station BP 08-0932, Cotonou, Benin
Segda, Zacharie	Institut de l'environnement et de recherches agricoles	INERA,BP 208, Fada N Gourma Burkina Faso
Traore, Karim	Institut de l'environnement et de recherches agricoles	INERA, BP 910, Bobo-Dioulasso Burkina Faso
Zougmore, Robert	Institut de l'environnement et de recherches agricoles	, PO Box 7192, Ouagadougou Burkina Faso
Mbog, Jean	MINREST/IRAD Institut de la Recherche Agricole pour le Développement,	MINREST/IRAD Nkolbisson, P.O. Box 2067, Messa, Yaounde Cameroon
Alphonse Youri	Institut de la Recherche Agricole pour le Développement IRAD	Agronome, IRAD-Garoua IRAD, BP. 415 Garoua, Cameroon
N'guessan, Alphonse	Centre National de Recherche Agronomique (CNRA) /Ferke,	CNRA/Ferke, 01 BP 635 Baouke 01, Cote d'Ivoire
Mathias Becker	West Africa Rice Development Association	WARDA, BP 2551, Bouake, Côte d'Ivoire
Dembele, Elie	DDRS, CMDT,	DDRS, CMDT, PO Box 1, Koutiala Mali
M'piè Bengaly	Institute of Rural	Production Systems and Natural Resources

	Economy, Mali	Management Team (ESPGRN) Institute of Rural Economy, Sikasso PO Box 186, Sikasso Mali
Kouyate, Zoumana	IRE Institut d'Economie Rurale	IRE, PO Box 214, Segou Mali
Adeoye, K.B.	CCROP NET (Network Moderator) Institute for Agricultural Research/Ahmadu Bello University	IAR, ABU, PMB 1044, Zaria Nigeria
Akele, S.E.A.	Green Rivers Project Nigerian Agip Oil Co. Ltd.	Green Rivers Project Nigerian Agip Oil Co. Ltd. New Base, Mile 4 Nigeria P.O. Box 923 Port Harcourt Nigeria
Fadayomi, R.O.	University of Ilorin,	University of Ilorin, PMB 1515, Ilorin, Nigeria
Francis, Ademola, O.	DADP	DADP, P.O. Box 1923, Ijebu Ode Nigeria
Ikeorgu, John	National Root Crops Research Institute	NRCRI, PMB 7006, Umuahia Nigeria
Mcnamara, Nora	Diocesan Development Services	DDS, PO Box 114, Idah Nigeria
Nwankpuma, Asaph	SUM-NRC	SUM-NRC, Agric Services, PMB 538, Abakaliki, Ebonyi State Nigeria
Pet Zoldt, Martin	Catholic Resource Centre	CRC, 10 North Road, PO Box 264, Kaduna Nigeria
Tanko, Roger	National Animal Production Research Institute/Ahmadu Bello University	NAPRI, ABU, PMB 1096, Zaria Nigeria
Agbemolo-Tsomafo, Prosper	Ecole Superieure d'Agronomie/ University of Benin/Togo,	University of Benin/Togo, ESA/UB, BP 1515, Lome

		Togo
Ambroise Fantchede	Centre de Recherche Agronomique de Littoral CRAL	CRAL, BP 2318, Lome, Togo
Fatou Gueye	ISRA/CDH	ISRA/CDH, BP 3120, Dakar, Senegal
Freddie Kwesiga (Regional Coordinator Of Southern Africa)	World Agroforestry Centre	SADC-ICRAF Regional Agrofrorestry Programme P.O. Box MP 128, Mount Pleasant, Zimbabwe
Ken Giller	University of Wageningen	PP, Haarweg 333, 6709 RZ Wageningen, Netherlands
CIMMYT	CIMMYT	CIMMYT Apdo. Postal 6-641 06600 Mexico, D.F., Mexico

Availability announced using:

Fallownet discussion list
An English language discussion list on soil fertility and indigenous fallow management in the tropical uplands.

MULCH-L discussion list
An English language discussion list for the interdisciplinary exchange of information on cover crops, green manures, managed fallows and other woody/non-woody mulch-based agricultural systems in tropical and sub-tropical areas sponsored by the Cornell International Institute for Food, Agriculture and Development's (CIIFAD) Management of Organic Inputs in Soils of the Tropics (MOIST) Group.

EVECS-L discussion list
A French language discussion list for tropical cover crops, green manures and mulches maintained by The Centre for Cover Crops Information and Seed Exchange in Africa (CIEPCA) in collaboration with CIIFAD's MOIST Group.

COBERAGRI-L discussion list,
A Spanish language discussion list for tropical cover crops, green manures and mulches. maintained by the International Cover Crops Clearinghouse (CIDICCO) in collaboration with the Management of Organic Inputs in Soils of the Tropics Group (MOIST) at the Cornell International Institute for Food, Agriculture and Development (CIIFAD).

Legume Research Network Project Newsletter
A biannual newsletter of the Kenya Agriculture Research Institute on the integration of legumes into smallholder agriculture in Kenya.