LIVING WITH THE TREES OF LIFE

TOWARDS THE TRANSFORMATION OF TROPICAL AGRICULTURE

ROGER LEAKEY

'On the face of it, Roger Leakey's contention – that, through the careful integration of trees on farms, there is more than enough capacity to produce food to meet the needs of a growing world population – is a bold one. But in this very readable volume, which dovetails Roger's accumulated wisdom from a distinguished research career with his barely disguised passion to improve the lot of poor smallholders worldwide, he demonstrates convincingly that it actually can be done. Read it, believe it and pass the news on.'

Mike Turnbull, Chairman, International Tree Foundation, Crawley Down, UK

'A fine, wise and enormously important book about trees and people, showing how we can live better by redesigning agricultural systems. More sustainable systems can work, and this book draws on evidence to show how production systems can be good for both people and the planet.'

Jules Pretty, Deputy Vice-Chancellor of Science & Engineering and Sustainability & Resources, University of Essex, UK

'*Living with the Trees of Life* presents practical, common sense solutions that will uplift and empower farmers, educators, assistance providers, and policymakers.'

Craig Elevitch, Director, Agroforestry Net, Hawaii, USA

'Roger is something of a visionary, and this inspirational book presents powerful evidence of what can be achieved through a lifetime's dedication, hard work and by building a multidisciplinary team.'

Prof. Adrian Newton, Professor of Conservation Science, University of Bournemouth, UK

'Part personal journey, part scientific biography, this book charts the evolution of agroforestry from an under-researched traditional farming practice to an interdisciplinary and transformative approach to agriculture…Read it and be inspired!'

Dr Kate Schreckenberg, Coordinator, Centre for Underutilised Crops, University of Southampton, Southampton, UK

'If you read only one book this year about the challenges facing global society, this is the one for you!'

Dr Charles Clement, National Research Institute for Amazonia, Manaus, Amazonas, Brazil

'A must-read for those who take sustainable food security provision in the tropics seriously.'

Prof. Patrick van Damme, Plant Production Department, Tropical and Sub-tropical Agriculture and Ethnobotany Laboratory, University of Ghent, Belgium

'We cannot afford to ignore the principal message that unfolds as a legacy of Roger's rich experience in agroforestry: that we can empower the peoples of developing tropical economies with productive and socially and environmentally sustainable strategies to ensure a brighter future for all.'

Prof. Paul Gadek, Centre for Tropical Agri-Tech Research, James Cook University, Cairns, Australia

'This account is inspiring and thought-provoking both for the student and the seasoned practitioner of sustainable land use and agricultural development. It is also an excellent introduction for the interested layperson.'

Dr Goetz Schroth, Federal University of Western Pará, Santarém, Brazil

'There is a growing appreciation for the value of agroforestry, and this book will contribute to the wealth of knowledge needed by a variety of practitioners – from farmers, teachers, researchers, and policymakers.'

Prof. Judi Wakhungu, Executive Director, African Centre for Technology Studies, Nairobi, Kenya

'This book could not have come at a more opportune time. Leakey's knowledge, deep wisdom, scientific expertise and long years in the service of smallholder farmers, and of the "trees of life" that sustain them, make him the ideal storyteller to show how science can be melded with traditional knowledge to develop workable agroforestry solutions to the many crises that confront life on earth. This is a book that can truly help the "bottom billion".'

Joan Baxter, Senior Research Fellow, Oakland Institute, California, USA

'Roger Leakey's book considers the huge challenges for the poorer nations of the world and the responsibility of developed countries to engage in the debates about sustainable food security, competing uses for land, and the development of new resources to meet the demands of local communities for food and fuel.'

Fiona O'Donnell, Member of Parliament for East Lothian, House of Commons, London, UK

'I cannot think of any better person to write this book, which brings new understanding to pervasive problems across the human–environment–development interface. There is no doubt that this book will become a seminal text for agricultural, development and environmental planners, policy-makers and practitioners throughout the world.'

Prof. Charlie Shackleton, Head of Environmental Science, Rhodes University, South Africa

'Although I am a forest tree geneticist engaged in breeding for industrial tree plantations, my long association with agroforestry and participatory tree domestication has convinced me of their central contribution to paths out of poverty for the rural tropical poor, and for a sustainable world.'

Dr Chris Harwood, CSIRO, Tasmania, Australia

Living with the Trees of Life

Towards the Transformation of Tropical Agriculture

To Alison, Andrew and Chris

Front cover image: Two farmers, FOUDA Bernard and MAMOLE Angeline from Ngali II (Centre Region of Cameroon), examining fruits of safou (*Dacryodes edulis*) or African plum, a highly nutritious and widely traded local food.

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Towards the Transformation of Tropical Agriculture

Roger R.B. Leakey

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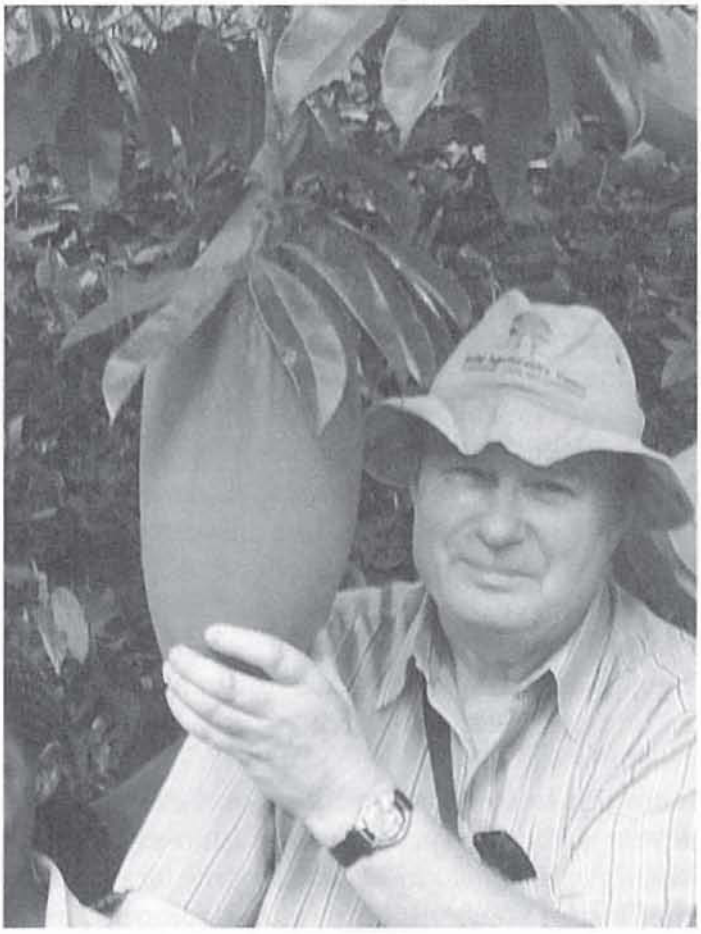
About the Author



Professor Roger Leakey DSc, PhD, BSc, NDA is a former Director of Research at the International Centre for Research in Agroforestry (ICRAF, 1993–1997) and Professor of Agroecology and Sustainable Development of James Cook University, Cairns, Australia (2001–2006). He is Vice President of the International Society of Tropical Foresters and is Vice Chairman of the International Tree Foundation. He holds a number of fellowships in learned societies, universities and international research centres. He was a coordinating lead author in the International Assessment of

Agricultural Science and Technology for Development (IAASTD), which was approved by 58 governments in an intergovernmental plenary meeting in Johannesburg, South Africa in April 2008. This assessment examined the impact of agricultural knowledge, science and technology on environmentally, socially and economically sustainable development worldwide over the last 50 years, and suggested that to meet these challenges agriculture has to advance from a unifunctional focus on food production and to additionally embrace more environmental, social and economic goals – i.e. to become multifunctional.

To advance agriculture in this direction, the author initiated what has become a global programme to start the domestication of wild fruit and nut trees that were the staple diet of people before the Green Revolution raised the profile of a few starch crops. This involved the development of some robust horticultural techniques that can be implemented in remote corners of the developing world, as well as some basic studies of the biology of potential food crops that are unknown to most of us.

This book presents the story of these changes in agricultural philosophy within the context of the author's personal experience of travelling and working in many countries of North, Central and South America and the Caribbean, Africa, the Middle East, South and South-east Asia and Oceania.

Foreword

How the world provides food for the 7 billion people alive today and the more than 9 billion people by mid-century will in large part define whether a sustainable future is possible for humanity.

The models upon which food production has been predicated over the past century or so are unlikely to meet the challenges of the coming decades if the world is to overcome poverty and grow economies while also keeping humanity's footprint within ecological boundaries.

These challenges have been recognized for the last 20 years, including at the Rio Earth Summit of 1992 and underlined in a series of landmark reports including: the Millennium Ecosystem Assessment of 2005; the UNEP Global Environmental Outlook 4 and the Comprehensive Assessment of Water Management in Agriculture of 2007; the International Assessment of Agricultural Knowledge, Science and Technology for Development in 2009; and The Royal Society's 'Reaping the Benefits: Science and the Sustainable Intensification of Global Agriculture' report of 2010.

In *Living with the Trees of Life*, Roger Leakey, an agricultural research scientist with long field experience in the tropics analyses and presents case studies on how agroforestry offers innovative and compelling pathways towards food security, human well-being and environmental sustainability.

The book underlines how modern science and improved varieties of trees allied to centuries-old knowledge can provide a new set of marketable products of special importance to poor and marginalized people in the tropics and sub-tropics, while simultaneously rehabilitating degraded land and restoring soil fertility.

Unlike many books on the future of food and agriculture, this one does not fall into one or other camp in respect to the way forward. Dr Leakey draws on scientific and technical lessons from the Green Revolution of the 20th century, while also spotlighting those from agroforestry and organic and conservation agriculture.

Indeed the development of the argument in favour of multifunctional agriculture is a refreshing departure from the polarized and often sterile one-size-fits-all viewpoints that dog much of the food and agriculture debate.

The book deserves to be widely read: it is rich in imaginative but highly practical ideas – ones that offer real and tangible opportunities to transform subsistence agriculture while bringing degraded land back into production.

It offers a vision and a blueprint in which there is reduced pressure on forests; farmland with a more diverse set of crops and landscapes that protect watersheds are a better habitat for wildlife and sequester more carbon that, in turn, can help to combat climate change.

In doing so, it makes an important contribution to the transition towards the low carbon, resource efficient Green Economy so urgently needed in the 21st century.

Achim Steiner
UN Under-Secretary General
and Executive Director,
UN Environment Programme (UNEP)

Preface

> There are some common misconceptions about agroforestry that this book tries to address. Agroforestry is a low-input approach to agriculture, but it does not run counter to the Green Revolution. Instead, it is an approach to correct some of the mistakes of the Green Revolution and to increase the productivity of modern crop varieties. It thus aims to improve the returns on the investment in the Green Revolution. If widely adopted, it should then open new windows of opportunity for agri-business and help to achieve the origin objectives of the Green Revolution to overcome hunger, malnutrition and rural poverty.
>
> Roger Leakey (2012) The intensification of agroforestry by tree domestication for enhanced social and economic impact. In: *CAB Review: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*. CAB International, Wallingford, UK.

To me the Garden of Eden conjures up images of lush vegetation in a land with plenty of natural resources where people live in equilibrium with their environment, eating alluring and little-known fruits and nuts – the 'Trees of Life'. I've lived and worked in the tropics most of my life and been lucky enough to see a few places where these images are not too far from the truth. In these places the Trees of Life are often as important today for food and balanced nutrition as they were hundreds and possibly thousands of years ago. These are not 'famine foods'; they are important resources for everyday life that are widely consumed and locally marketed. They have potential to be cultivated as new crops. Today, places where these species are found in profusion are the rare exceptions. Living and working in the tropics means that you far more often see places where these images are only a distant memory in the minds of the current older generation. The reality is that in many places Eden has been destroyed – forests are dwindling, the trees are becoming isolated, women are walking further to get fuel, people are hungry, soils are impoverished, the environment is damaged, erosion is causing landslides, unseen gases are escaping into the atmosphere and affecting the climate, and there is the smell of smoke from burning rubbish and vegetation, as well as from cooking fires. Make no mistake, the bad news, the 'doom and gloom' about tropical forests – over-exploitation of natural resources, the high incidence of poverty, malnutrition, hunger and disease – is real. These

issues are not about to go away unless we find the political will to think very differently. Hopefully this book will open the eyes of people who can bring about this change in development policy; especially agricultural policy vis-à-vis poor smallholder farmers in the tropics.

Currently, despite decades of agricultural research, billions of people are still both poor and hungry and the planet is under threat from a food crisis arising from social deprivation and a range of environmental disasters that are associated with land degradation, and a changing climate. We are all familiar with such doom and gloom, but is there any hope of improving the situation? Based on our current experience, it seems that economic development and environmental protection are mutually exclusive; but is this really true? We have to ask ourselves: 'Have we genuinely tried to find a way to meet the food and wealth needs of all people in the growing population of our planet without causing environmental damage? Is economic growth achievable without over-exploitation of natural resources?' The answers to these questions have been elusive.

This book presents what I believe to be good news, as I have personally seen evidence from the tropics that convinces me that the world can easily support a population in excess of the currently projected 9 to 10 billion and that the poor can be substantially better off than they are now. I'm saying this as an agricultural scientist. I've been very fortunate to be personally involved in the work that has produced this evidence. So this book is an account of my personal experience, not just another report pulled out of a filing cabinet.

I will endeavour not to over-emphasize the good news and so give a false impression of the current situation. However, I hope that if enough people are encouraged by some good news it may be possible to hasten the development of a much-needed productive form of tropical agriculture that is also environmentally friendly. But what are the missing ingredients that make this dream so difficult to realize? Is it the loss of soil fertility or the lack of cash that prevents poor, smallholder farmers from harnessing the benefits of the 'Green Revolution'? Could solving these problems lead to a major new initiative in which food security and income generation run hand in hand with the rehabilitation of degraded farmland?

The prospect of good news may sound far too good to be true, but as a research scientist, I have spent much of my life trying to develop techniques and strategies that can be used by poor farmers in the tropics to empower themselves to greater self-sufficiency, and then to help them to build on that experience to raise themselves out of the 'poverty trap' that has ensnared them. To some extent this has meant the difficult task of trying to innovate in areas that are not fashionable in modern agricultural science, while also raising research questions that even now, despite the amazing things that are possible, are difficult to answer through science.

So is good news justified? Yes. It is also essential, as good news is usually drowned by bad news, which is more marketable than good news.

Without good news it is difficult to initiate and sustain any efforts to solve problems. Good news offers some reason for hope. In the absence of hope, despondency sets in and the only release for concerned people is to switch off, or to bury their concerns.

My story represents a journey, both geographically around the world to remote and interesting places in Africa, Asia, Latin America and Oceania, as well as through an unusual career in agroforestry,[1] developing practical solutions to the big global issues affecting mankind. Both journeys create worrying, amusing and interesting situations, some of which are woven into the more serious message of the book – how to overcome poverty, malnutrition, hunger, land degradation and even climate change, and so to recreate Eden. The Trees of Life are central to this story and have been very much part of my life. As we will see, I believe they can also play a critical role in the future of our world. So, I will try to weave these storylines together into the much bigger cloth of sustainable economic development with its over-arching social and environmental issues. Doing this as a biologist, I am aware that I will be skating on thin ice, as I am not a social scientist, economist or development expert. However, I have had the opportunity to work with people of many other disciplines and I hope some of their expertise has rubbed off on to me. Based on this assumption, I will make my case in an attempt to bridge some of the conceptual and professional 'disconnects' between disciplines and organizations, which I believe are part of the reason we have the big environmental and social problems facing agriculture worldwide. In a sense we have 'the blind leading the blind', as it seems that economists and policy makers often ignore the insights of biologists and ecologists, and vice versa – not a good recipe for economic growth with social and environmental sustainability.

It seems to me that another reason for some of our big global problems is that we – mankind – are not very good at examining the issues before suggesting solutions. I am deliberately excluding women from this criticism, as I think they have had a better vision of the issues, but sadly their voices have not been heard. I think agricultural development is a case in point. I therefore try to analyse the issues in Chapters 2 and 10, and then base the rest of the book on an approach that seems to me – another male – to address the pertinent issues.

I am aware that on occasions I will be stepping outside my area of expertise – my comfort zone. I will probably offend some of my colleagues and readers who are experts in these other fields. If so, I apologize. Nevertheless, I excuse my transgressions in the hope that by trying to set agroforestry in context, I will open a few eyes to new possibilities for the improvement of agriculture and Third World development. If you are an expert in one of the areas where I miss the mark, I hope that at least you will learn something about agroforestry and that you may be stimulated

to improve the linkages between your work and that of agroforesters. In this way the number of disconnects can be reduced and the overall level of understanding among our peers be improved.

I will be bringing together information from my work about how we can encourage the spread of what I will call 'multifunctional farming systems', as well as how to improve their productivity and capacity to generate income. I will be explaining how agroforestry research in the tropics is 'domesticating' some of the Trees of Life by bringing them into cultivation as new crops that meet the needs of local people. None of this is rocket science. It is something that is readily attainable. However, success is dependent on politicians and policy makers having the will to think differently about how to reduce poverty, hunger and malnutrition. Actually, this new way of thinking is something we ought to be doing anyway, as it is also highly compatible with some of the lifestyle changes that we need to be implementing if we are to mitigate the impacts of climate change and conserve wildlife. So, if we put our minds to it, a better world, a new Eden, could be around the corner.

I've said that capturing the environmental, social and economic benefits of trees is not rocket science, and this is true. However, it does have complexity simply because it involves many different and interwoven forms of biological, ecological, environmental and social science. In this sense it is much more difficult than planting a field with a new variety of maize or rice. This complexity makes it relatively difficult to explain over a drink in a bar or at a dinner table, when someone asks 'and what do you do?'. I know that I have failed to get the message across on many such occasions, hence my decision to try to get it all down in black and white in this book, in what I hope is an understandable manner.

'What do you do?' is a question that, like most people, I am frequently asked in everyday conversation. The questioner is expecting a simple answer: 'oh I'm a doctor/solicitor/accountant/businessman'. But for me the answer is not that easy. There are dozens of potential answers that I can give to this question, so my reply tends to reflect my mood, or the sort of answer that I guess might interest the questioner. So, what are the answers? Well, there are those that reflect my employer, things like 'well, I'm a civil servant' or 'oh, I'm an academic', 'I work in overseas development', 'I'm a consultant'. Alternatively, there are the academic disciplines that I am engaged in: 'I'm a forester/horticulturalist/agriculturalist/ecologist/agroforester/food scientist/tree physiologist'. Once, at a party, the last of these options elicited a blank look, the questioner moved on to other chit chat with people standing nearby, and then came back half an hour later: 'Tell me, what does a tree psychologist do?' If I had not been so taken aback by this question, I might have answered 'Oh, well, the buzz of a chain saw gives trees the jitters, you know. We talk to trees and try to sort out their emotional problems – these typically stem from the rate of deforestation.'

Disciplines and professions are not really a very good answer to the question 'what do you do?', as I really work at the interface between all these disciplines, and I could perhaps add 'social science'. Therefore it is sometimes easier to describe the ways that I spend my time: 'I'm a research scientist/writer/fund raiser/manager/administrator,' or 'I'm in agribusiness'. If I'm feeling flippant, I could add 'I travel a lot, visiting airports all around the world and see how well they are functioning'. If, on the other hand, I feel that the person I am talking to is genuinely interested to know what I do, and not just making conversation, then I can answer: 'Well, I am developing techniques and strategies to try to overcome some of the big problems facing people in developing countries around the tropics – things like poverty, deforestation and environmental degradation, and malnutrition.'

Now we are getting to the heart of the matter. So, *Living with the Trees of Life* is my attempt to answer the questions 'what do you do?' and 'why do you do it?' more efficiently than I have ever managed in any conversation, with anyone, including, I suspect, my wife and family, and certainly many friends and work colleagues. Many friends and acquaintances are just aware that I am always coming back from, or about to go to, some remote corner of the world. Many of these people, especially some of my former bosses, think that my life is one long holiday travelling to exotic locations. On many, many occasions this is far from the truth and I am staying in remote villages, eating unusual local food, sweating and swatting mosquitoes or the vectors of other nasty tropical diseases. What makes this worthwhile is that my experience of farmers in developing countries is the friendliness of their welcome and their willingness to interact and participate in studies involving their farms, despite their hardships, poverty and other problems. I also spend a lot of time milling around in boring places like airports and in the offices of government officials waiting to get permissions and agreements. My waiting skills are well honed.

I hope that through my experience I have some insights into the complex multidisciplinary issues surrounding the sustainability of agriculture in the tropics. One of the problems of modern life is that we are all trained in the ever increasing detail of our different disciplines. As a consequence we are less well equipped when we get into jobs in which interaction between disciplines is needed to address the numerous disconnects in the way we view issues of everyday life. Indeed, it seems to me that the world now needs people who are trained in 'multidisciplinary studies'. I hope this book will give people from very different disciplines an insight into a more multidisciplinary approach to agriculture and to the resolution of some of the big global issues that stem from our current approach.

Finally, as a biological scientist, I am used to justifying my remarks by reference to the scientific literature. In this book I have kept this to a minimum in an attempt to make the text more readable. This could leave me open to criticism by 'experts'. To reconcile this predicament, I present

some of my formal publications in 'Further Reading' for those who wish to assure themselves that my remarks are supported by academic literature.

Professor R.R.B. Leakey
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Note

[1] Agroforestry is an umbrella term that covers a wide range of land use systems in which trees are integrated into the farming system.

Acknowledgements

I especially thank my parents for the life-shaping experiences of my childhood and the sacrifices they made for my education. My career and family life started at the same time, with my marriage to Alison Swan a few months after landing my first job at the Institute of Tree Biology. This book is about my career and working life, and not the family. However, my career, especially the overseas travel, interrupted family life. I was away from home about half of the time, usually on trips of 1–3 weeks, although occasionally longer. This meant, of course, that much of the daily burden of household jobs and looking after the needs of our boys, Andrew and Chris, fell on my wife Alison. She suspended her teaching career for many years to take on extra duties. My travels also meant that our boys grew up with a father who was unable to fully fulfil his parental duties. I greatly regretted this, but just occasionally I could provide some compensation by hooking a family holiday on to an overseas trip. I'm pleased to say that my absences do not seem to have had serious detrimental effects on the boys, who have grown up and done extremely well. They are now in the early years of their own careers, also in biology and environmental sciences. I am very grateful to Alison for making such a good job of being mother and part-time father.

I also take this opportunity to sincerely acknowledge everyone who has contributed to the richness of my career experience, especially my numerous work colleagues who have contributed to my knowledge and the formulation of my ideas. I also thank the numerous donors who funded our work, as well as the community partners and farmers in many parts of the world who made it all happen. In the chapters that follow and the endnotes, I mention many of you, but I certainly have not mentioned all of you – so please don't take offence if you have not been mentioned. It doesn't mean that your work was any less appreciated; it is just that there is a limit to what I can include in this book.

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Photographs

With the exception of Fig. 9.2, the photographs were taken by the author.

Frequently Used Acronyms

ACIAR	Australian Centre for International Agricultural Research
AFTP	Agroforestry tree product
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza in Costa Rica
CEH	Centre for Ecology and Hydrology (formerly Institute of Terrestrial Ecology, ITE) of Natural Environment Research Council (NERC) in the UK
CGIAR	Consultative Group on International Agricultural Research
DFID	Department for International Development (formerly ODA, see below) in the UK
FAO	Food and Agriculture Organization of the United Nations
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
ICRAF	International Centre for Research in Agroforestry (now the World Agroforestry Centre) in Kenya
JCU	James Cook University, Cairns, Australia
ODA	Overseas Development Administration (now DFID) in the UK
UNESCO	United Nations Educational, Scientific and Cultural Organization