

Full Length Research Paper

Tailoring tertiary agricultural education for sustainable development in Sub-Saharan Africa: Opportunities and challenges

S. Chakeredza^{1*}, A.B. Temu², J.D.K. Saka³, D.C. Munthali⁴, K. Muir-Leresche⁵, F.K. Akinnifesi¹, O.C. Ajayi¹ and G. Sileshi¹

¹World Agroforestry Centre (ICRAF), P.O. Box 30798, Lilongwe 3, Malawi.

²World Agroforestry Centre (ICRAF), P.O. Box 30677-00100, Nairobi, Kenya.

³Chancellor College, University of Malawi, P.O. Box 280, Zomba, Malawi.

⁴Botswana College of Agriculture, Private Bag 0027, Gaborone, Botswana.

⁵136 Rocklands Rd, Rooiels, P.O. Box 343, Betty's Bay, Cape Town, South Africa.

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Sub-Saharan Africa's economic growth hinges on the development and promotion of a vibrant and sustainable agricultural production base. The prime movers for sustainable agricultural production include: availability of improved technologies, human capital, sustainable growth of biological and natural resource capital, improvement in performance of supporting institutions and favourable economic policy environment. Central to making these components operational is the production of suitable graduates, who are (i) technologically competent and relevant, ii) equipped with the necessary "soft skills" and business skills and (iii) able to work with local and especially rural communities. In this paper we review the current weaknesses in the tertiary agricultural education system and propose the necessary changes to be instituted. It is projected that the number of hungry people in Africa will continue to increase further in the 2020s. To turn the continent around, tertiary agricultural education must be transformed. Issues of faculty retention, institutional management, curricula content and education delivery, urgently require review and re-designing. We demonstrate the "best practices" which if replicated on a wide scale can move the continent in the desired direction.

Key words: Sub-Saharan Africa, tertiary agricultural education, curricula content and delivery, institutional management.

INTRODUCTION

The livelihood situation in Africa has been described as dire and deteriorating (Diao et al., 2006). Africa is the only continent where hunger and poverty are projected to get worse. Statistics show that 80% of all Africans live on a daily income of less than US\$ 2 while nearly half struggle to survive on US\$ 1 a day or less. More than 200 million Africans now suffer from malnutrition (Rosegrant et al., 2005).

If change is going to be achieved in Sub-Saharan Africa (SSA), then agriculture, particularly small holder agriculture has to be made to work. From the National Level (through Poverty Reduction Strategy Papers), to the continental level (through the Comprehensive Africa Agricultural Development Programme) to the global level

(Millennium Development Goals; Von Braun et al., 2004), the small holder sector has been shown to be pivotal for economic development. The New Partnership for African Development (NEPAD) has the ambition to achieve a 6% annual growth in agricultural GDP over the next 20 years. However, the attainment of this growth level requires fundamental changes in the agricultural institutions and practices, including substantial improvements and investments in agricultural research, extension and education.

Central to the desired transformation is the need to increase the productivity and competitiveness of African agriculture. The paper proposes a vision focused on preparing professionals capable of leading change, with universities playing their roles in the development process.

Thus we review the role of agriculture in development of SSA and identify best practices in agricultural education that can be improved and scaled up. We conclude by proposing agenda for progressive action to-wards realisation of the goal for the production of agricultural graduates who will be relevant to the current socio-economic conditions prevalent in the greater SSA.

ROLE OF AGRICULTURE IN SUB-SAHARAN AFRICA DEVELOPMENT

Agriculture remains the foundation of SSA's dominant economic activity accounting for 40% of GDP, 15% of exports and 60 to 80% of employment (Diao et al., 2006). Productivity of African agriculture over the last two decades has generally stalled. Per capita output of staple foods continues to fall and the continent is steadily losing its world market shares for major export crops like coffee, tea and cocoa. Improving performance of Africa's stagnating agricultural sector is a key to solving the problems of hunger and poverty. The only way of ensuring improved African agriculture is ensuring that the prime movers for its development are in place.

Prime movers to agricultural development

Rukuni (2002) lists five basic prime movers which should work in a concerted manner to achieve sustainable agricultural development. These include:

- New technology produced by public and private investments in agricultural research or imported from the global research system and adapted to local conditions. Human capital in the form of professional, managerial and technical skills produced by investments in schools, agricultural colleges, faculties of agriculture and on the job training and experience.
- Sustained growth of biological capital (genetic and husbandry improvements of livestock herds, crops, forests, plantations and so on) and physical capital investments (large and small dams, irrigation, grain stores and roads). Improvements in the performance of institutions such as marketing, credit, research, extension and land reform.
- Favourable economic policy environment.

*Corresponding author. E-mail: Schakeredza@africa-online.net. Tel: +265(0)1 707329. Fax: +265 (0)1 707319.

Abbreviations: BCA, Botswana College of Agriculture; EARTH, Escuela de Agricultura de la Región Tropical Húmeda; NEPAD, New Partnership for African Development; RUFORUM, Regional Universities Forum for Capacity Building in Agriculture; SEMCIT, Sustainability, Education and the Management of Change in the Tropics; SEP, Supervised Enterprise Project; SSA, sub-Saharan Africa.

No single prime mover, such as new technology or higher prices can increase agricultural production and sustain it for any period of time. However, central to making the prime movers operational is the production of necessary human resources to man the different institutions which will "get agriculture moving".

Tertiary agricultural education

Higher education in agriculture and natural resource management plays a particularly significant role in national development (Maguire, 2000). The major focus of tertiary agricultural education has been on the production of public sector employees (Muir-Leresche and Scull-Carvalho, 2006). Traditionally, graduates have largely found employment in ministries of agriculture, universities, state operated enterprises and other government functions. Agricultural graduates have worked as policy advisers, lecturers, researchers, extension workers, business managers and financial experts.

Growth and management of institutions

Over the past two decades, there has been a steady increase in tertiary agricultural institutions on the SSA continent. There are currently over 200 universities, of which at least 87 teach agriculture and natural resources (Temu et al., 2003). An estimated 23,000 qualified academic professionals including many from the agricultural sector emigrate from Africa each year (BASIC, 2006). As a result there is poor staffing in tertiary agricultural institutions (Okori and Adipala, 2007).

The criteria for student admission into the Universities include: successful completion of secondary school education; a particular number of points on finishing secondary school and the particular student's preference (Muir-Leresche and Scull-Carvalho, 2006). Although women carry out much of the farming burden in Africa, they are poorly represented in agricultural education programmes. They form only 12-15% of the undergraduate enrolment (BASIC, 2006).

Students of agricultural faculties are all-too-often not there by choice. Frequently they are there by default after failing to enrol for medicine, veterinary science, business studies, and engineering among other popular programmes (Muir-Leresche and Scull-Carvalho, 2006). This has a bearing on the graduate being produced.

Curriculum content

It is generally agreed that training of agricultural professionals in SSA is predominantly based on curricula adopted from countries that had colonies in Africa (Temu et al., 2003). The curricula were founded on an agricultural philosophy and policy that aimed at the production of

cash crops for consumption by the colonising countries. It is further contented that the content of materials used for teaching and learning has often been adopted from other parts of the world without adequate contextualisation and adaptation to local environments (Temu, 2004). Most of the faculties have obtained the graduate qualifications in universities with curricula designed to serve large-scale, capital intensive agricultural systems. Without adaptation, the dairy, beef, pig, poultry, maize, vegetable and horticultural production systems and models used have limited relevance to an isolated, resource-poor rural farmer in Africa.

Curriculum delivery

Curricular delivery has been based on rote learning, memorisation of facts and reproduction of the same at examinations. The method used has largely been over 70% class teaching with library assignments and laboratory work making the other 10 - 30%. Conventional assessment of rote-learned information using closed-book examinations is the norm.

Very little interaction with farming communities takes place to enrich the learning programme (Bekunda et al., 2007). In fact, most of the universities are located in towns where there are no farming communities to work with nearby. As a result, the communities who are supposed to be benefiting from the universities are not benefiting.

In most cases the farming community is not involved in the design and delivery of agricultural curricula. Furthermore, private sector involvement in the design and delivery of curricula has also not taken place or even where there is some consultation, it tends to be sporadic. Few universities have participatory mechanisms institutionalised to incorporate stakeholder input.

WHAT NEEDS TO CHANGE?

Over the past two decades, a number of seminars and symposia have taken place in trying to address the shortcomings of tertiary education delivery in SSA. These seminars include the SEMCIT (Sustainability, Education and the Management of Change in the Tropics) seminar series which ran from 1999 to 2003 involving a network of 360 people from 73 countries and 198 institutions around the world (SEMCIT, 2003); The ANAFE (African Network for Agriculture, Agroforestry and Natural Resources Education) symposium of 2003 which brought together 127 persons from 25 countries (Temu et al., 2004); and recently the RUFORUM (Regional Universities Forum for Capacity Building in Agriculture) symposium of 2007 which brought together 12 universities from East and Southern Africa (RUFORUM, 2007).

From these seminar series it was noted that:

- The current curricular delivery lacks practical training. There are limited opportunities for students to come into contact with the farming community, to work with farmers and their families and to better understand the dynamics of rural development.
- The focus on curricula delivery is based almost exclusively on the acquisition of technical and scientific knowledge within narrowly defined disciplines. These traditional approaches are inadequate to the task of preparing professionals for the challenges of the future.
- The graduating students do not have the conceptual and practical skills related to initiating and operating an agricultural enterprise. It was also noted that public sector employment opportunities were dwindling.

Since the universities have currently been found to be lacking in delivery of the graduates demanded by the industry and communities, there is a need for transforming tertiary higher agricultural education into producing effective drivers of agricultural and rural development.

TRANSFORMING TERTIARY AGRICULTURAL EDUCATION

The need for the production of a new form of graduates is not disputed. The SEMCIT seminar series, ANAFE and RUFORUM symposia referred to earlier, have classified the type of graduates who should be produced in the tertiary agricultural institutions. The results converge on a desire to have graduates who:

- Possess social consciousness and are connected and committed to rural communities.
- Have strong entrepreneurial skills and spirit, and are capable of initiating new job opportunities.
- Are guided by positive values and high ethical standards; are committed to a new vision of agricultural production compatible with the natural environment and the conservation of biodiversity.
- Have a solid grounding in the scientific and technical principles that underlie practice as well as the practical experience critical to developing confidence coupled with a generalist preparation that will enable them to develop holistic solutions to the problems that they will encounter in their careers.
- Are innovators with the confidence to be creative and address real problems are life-long learners capable of taking advantage of relevant information as it is generated and to take advantage of new information technologies.
- Possess strong leadership, interpersonal and team-building skills and demonstrate strong communication skills, including effective use of international business languages and information technology.

What then are the ingredients which ensure that the proper type of graduate for the needs of SSA will be produced by our agricultural institutions? Sherrard (2003) advances the idea that transforming higher education programmes in agriculture implies significant changes in the student selection process, the plan of study, the organisation of the programme and in the nature of curricular and co-curricular activities.

Faculty

The importance of attracting and retaining good faculty who are committed to both education and sustainable rural development and who are leaders in their field cannot be overemphasised. If new approaches to curricula delivery are agreed upon, then there is a need for faculty retooling. Faculty will need training in new concepts, methods and skills required for implementation of any desired change and develop competence in the new approaches.

The current brain drain affecting agricultural experts in SSA needs to be stemmed. It will be important to identify and solve the problems that lead to brain drain. The thesis that economic incentives outside SSA are the main reason is insufficient to explain the exodus. There are professional, social and security reasons which require intensive studies.

Student admissions

There are fundamental reasons why students do not choose agricultural degree programmes as a priority. These include *inter alia*, job opportunities, professional development prospects and the likely work environment. Without fundamental improvements in this area, the attraction of students will remain low. Policy and institutional interventions are pre-requisites. The next step is to select those students with a vocation in agriculture – including agricultural industries, marketing and trade. This diversifies the location and type of business for the graduates. The last strategy would be to make the learning programmes much more creative, interesting and exposing the learners to exciting opportunities for self development.

Much of Africa's small holder agriculture is in the hands of women. However, extension education efforts and enrolments in agricultural programmes have been biased in favour of men (Muir-Leresche, 2006). There are universities in Africa with programmes to encourage women but more needs to be done. For example Tanzania, Uganda and Zimbabwe are among the countries where the state universities take girls with lower entry grades than boys. In Tanzania, the proportion of female enrolment rose from 16% in 1992 to 29% in 1996. Recruitment efforts for higher education that target young women and program-

mes should be responsive to the needs of women (Adipala et al., 2007). The presence of positive female role models is critical.

Curriculum content and delivery

There is a need to change the processes for curricula reviews. The process should include faculty, students and external stakeholders like farmers, business persons, agro-industry, government and civil society (Rudebjer et al., 2005). The approaches must focus on integration of persons, institutions and processes involved in production, value adding, marketing, research and other areas (Oyewole and Lamptey, 2006). Information and communication technology (ICT) and integration of soft skills in general should be an integral part of the training.

The new approach should also emphasise the importance of entrepreneurial skills, including actual experience in planning and operating a productive enterprise as a means of preparing graduates for careers in the private sector, especially as independent entrepreneurs. Due to globalisation, students need to be aware of export opportunities for small farmers and commodity groups.

Interdisciplinary and multidisciplinary tolerance and experience should be encouraged. Muir-Leresche and Scull-Carvalho (2006) encourage focus in classes, laboratories, and other curricula activities to increasingly be placed on student-centred learning through active student participation; work in groups and discussion rather than formal lectures in which the professor imparts knowledge to the student.

The student assessment method automatically needs to change if changes in pedagogy and curricula are to be effected. Assessment strategies need to reflect new objectives. These may involve a range of different methods and may include employer and farmer and community assessments after attachments. Open-book exams, final year dissertations, field and literature research projects, development and entrepreneurial projects, oral presentations, debates, teamwork and independent knowledge searches, also contribute to a more student-focused learning system.

The SEMCIT seminar series, ANAFE and RUFORUM symposia alluded to earlier, have recommended that each country needs to ensure that few, very effective specialists, are produced. The majority of the graduates now need to be more involved in the broader rural development and agro-industrial chain. They also need to understand how government policies, institutions and infrastructure impact on the incentives and opportunities for small holders to participate in the market and to employ sustainable practices. Is there evidence of success in such approaches? Some interesting case studies are presented in the next section.

CASE STUDIES

Despite the widespread perception throughout that universities in general and agricultural and natural resource universities in particular need to transform, relatively few have demonstrated the ability to do so. Notable examples include the EARTH University in Costa Rica which has established an innovative agricultural training program and other universities which have developed innovative approaches in one or the other aspect of course delivery.

Earth university model

The EARTH (Escuela de Agricultura de la Región Tropical Húmeda) University is an International institution located in the humid tropics of Costa Rica. Sherrard (2003) discusses the EARTH University approach to higher agricultural education.

The University offers a 4 year Student-Centred Integrated learning programme. Emphasis is placed on teamwork, intercultural exchange, leadership and values. The University has a large campus farm that provides students ample opportunities for application and experimentation. The University is relatively isolated and is established in a rural area.

The admission process at EARTH seeks to identify candidates from rural areas who possess an agricultural vocation, social and environmental awareness and concern and a commitment to return to their region of origin.

The EARTH study plan emphasises processes and integration, with relatively less importance given to classes organised strictly along disciplinary lines. Week-long field trips to rural communities are organised in which faculty participate alongside students and during which students have the opportunity to analyse production systems in their social, environmental and ecological contexts. There are no departments at the University and Faculty are organised by the year they teach as opposed to disciplinary lines.

The entrepreneurial focus of the study programme begins in the first year of study. Students study and apply business skills as they develop enterprises. After forming a small business among 5 peers deciding on their enterprise and developing a business plan, the students present their plan and if accepted, are provided a loan, at market interest rates, to develop their enterprise. The students are responsible for implementing their project and after marketing, paying for their loan and labour, they then divide two-thirds of the profit among themselves, with one third reserved for the revolving loan fund. Many students have aspired to set up an enterprise on graduation. But because many come from low-income families and have no access to collateral to secure a loan, most do not qualify for a commercial loan. EARTH has established a loan fund to provide start-up capital for gra-

duates.

Since its inception in 1990, EARTH University has had high student retention percentages (88%). As of 2007, EARTH has graduated 1,082 students from 18 Latin American countries, Spain and Uganda. 68% of these graduates have entered the private sector, 9% work with NGOs, 10% have entered the public sector, 5% are carrying out postgraduate or other studies, 3% are seeking employment while there is no information on the remaining 5%.

Botswana College of Agriculture supervised enterprise project

Munthali (2004) discusses the Botswana College of Agriculture (BCA) Supervised Enterprise Project (SEP). The main objective of the SEP is to equip agricultural graduates with entrepreneurial skills that make them better prepared for employment in the private sector or self-employment.

The SEP program at BCA enables students to undertake chosen small-scale agricultural enterprises at BCA over a period of 10 months. The main objectives are to:

- Train students in the management of chosen agricultural enterprises in order to make them technically competent in agrobusiness.
- Equip students with financial and business management skills and provide them with practical experiences in issues relating to credit, loan repayment and record keeping.
- Enable students to accumulate capital (from profits earned from the SEP enterprises) for use as collateral later after they have completed the programme.

The BCA extends a loan of up to 75,000 pula (≈US\$ 10,000) to a student wishing to embark on a chosen agricultural enterprise. Students wishing to join the SEP programme are required to develop and submit project proposals and budgets that show the chosen enterprises and the projected costs and returns. After the proposals have been reviewed, they are funded. The SEP loans are charged on an economic interest rate and repayments of these loans start as soon as the first sales have been made. The students are also charged BCA rates for the use of any services or facilities offered by the college. On completion, the students take home any remaining profits after the sale of their commodities.

Under this programme, graduates are equipped with entrepreneurial skills that make them better prepared for employment by the private sector or for self employment. Initial results indicate that the first 12 graduates who undertook the programme made good profits in their chosen enterprise. It will be important to continually moni-

for the progress this first group of graduates make in their chosen enterprises.

THE IDEAL AGRICULTURAL GRADUATE FOR SSA: NEED FOR PROGRESSIVE ACTION

Evidence marshalled by Johnson and Hazell (2002); Rosegrant et al. (2005) and Diao et al. (2006) suggest that Africa's growth hinges on the growth of small holder agriculture. Tertiary agricultural institutions in SSA therefore need to produce appropriate agriculturalists that will play their part in contributing to the development of the agricultural sector. To continue to make progress in the production of an appropriate graduate, national, regional and international commitment and political will is needed. The following are some of the key elements which can ensure that progress towards the up-gradation of agriculture, as identified by NEPAD and others occurs:

- Improvement of tertiary agricultural education. This includes elements of institutional management, faculty attraction and retention. Student selection process needs to target those with a vocation in agriculture. There is a need to revamp and contextualise curricula content.
- Adoption of delivery methodologies that ensure maintenance of constant contact with communities should be maintained with a strong bias in favour of women participation since they form the majority of farmers in SSA.
- The "best practices" which have been implemented worldwide need to be documented so as to scale them up to reach many more institutions. There is a need to set up regional institutions along the lines of the EARTH University with a view to evaluating its potential to serve as model colleges.

Conclusions

Agriculture will continue to be the driver for economic growth in Sub-Saharan Africa for the foreseeable future. In order to "get agriculture moving" in the subcontinent, a trained cadre who is technologically competent and relevant; equipped with the necessary "soft skills" and business skills to generate employment and wealth and able to work particularly with rural communities should be produced. In this regard tertiary agricultural education must be transformed. Issues of faculty retention, institutional management, curricula content and education delivery need urgent attention. The way forward should ensure that there is a buy-in of these ideas from political leaders who would facilitate the change process and also ensure that the "best practices" are scaled-up rapidly.

REFERENCES

Adipala E, Masanganise P, Ombima W, Kongai H (2007). Building

- scientific and technical capacity: some lessons and needed actions. RUFORUM 2. First Biennial Meeting of the Regional Universities Forum for Capacity Building in Agriculture, 23-27 April, Mangochi, Malawi. Programme and Extended Abstracts. pp.17-20.
- ANAFE (2006). ANAFE (African Network for Agriculture, Agroforestry and Natural Resources Education). A brochure. Available at <http://www.anafeafrica.org> Accessed on 25th September 2007.
- BASIC (2006). BASIC (Building Africa' Scientific and Institutional Capacity in Agriculture and Natural Resources). An ANAFE Publication, p. 12.
- Bekunda M, Okori P, Kyamanywa S (2007). Promoting relevance of University training and research activities: The case of National Forum, Uganda. RUFORUM 2. First Biennial Meeting of the Regional Universities Forum for Capacity Building in Agriculture, 23-27 April, Mangochi, Malawi. Programme and Extended Abstracts. pp.25-28.
- Diao X, Hazell P, Resnick D, Thurlow J (2006). The role of agriculture in Development: Implications for Sub-Saharan Africa. IFPRI, Development Strategy and Governance Division, Discussion Paper No. 29. Available at <http://www.ifpri.org> Accessed on 28.09.07.
- Johnson M, Hazell P (2002). Cutting Hunger in Africa through Smallholder-led Agricultural growth. An IFPRI technical paper in support of USAID's Agricultural Initiative to cut hunger in Africa (AICHA). Available at: <http://www.ifpri.org/themes/aicha.htm> Accessed on 29.08.07.
- Maguire JC (2000). Agricultural Education in Africa: Managing Change. A paper prepared for workshop 2000 Sponsored by the Sasakawa Africa Association Accra and Cape Coast Ghana. Available at http://siteresources.worldbank.org/INTARD/825826-1111044795683/20424536/Ag_ed_Africa.pdf Accessed on 27.09.07.
- Muir-Leresche K, Scull-Carvalho S (2006). Improving approaches for effective teaching and learning: tertiary agricultural education. Nairobi: World Agroforestry Centre, p. 64.
- Munthali DC (2004). Training for self-employment in agriculture: the supervised enterprise projects of the Botswana College of Agriculture. In: Temu AB, Chakeredza S, Mogotsi K, Munthali D, Mulinge R (eds). Rebuilding Africa's capacity for agricultural development: the role of tertiary education. Nairobi: World Agroforestry Centre, ICRAF, pp. 138-145.
- Okori P, Adipala E (2007). Lead paper: Building human and institutional capacity for agricultural development: RUFORUM's framework. RUFORUM 2. First Biennial Meeting of the Regional Universities Forum for Capacity Building in Agriculture, 23-27 April, Mangochi, Malawi. Programme and Extended Abstracts. pp. 5 - 9.
- Oyewole OB, Lamptey A (2006). Higher agricultural education and international cooperation in African Universities: the synergic roles of AAU and WGHE. A paper prepared for the International Seminar on Higher Education. Available at: http://www.agropolis.fr/pdf/iipe/oyewole_texte.pdf Accessed on 28.09.07.
- Rosegrant MW, Cline SA, Li W, Sulser TB, Valmante-Santos RA (2005). Looking ahead: Long term prospects for Africa's Agricultural Development and Food Security. <http://www.ifpri.org/2020/dp/vp41.pdf> Accessed on 01.09.07.
- Rudebjer PG, Temu AB, Kung'u J (2005). Developing agroforestry curricula: A practical guide for academic institutions in Africa and Asia. Bogor: World Agroforestry Centre. p. 53.
- RUFORUM (2007). RUFORUM 2: Programme and Extended Abstracts. First Biennial Meeting of the Regional Universities Forum for Capacity Building in Agriculture, 23-27 Mangochi, Malawi. p. 366.
- Rukuni M (2002). Africa: Addressing Growing Threats to Food Security. J. Nutr. 132: 3443S-3448S.
- SEMCIT (2003). SEMCIT (Sustainability, Education and the Management of Change in the Tropics). An International Seminar series focused on the role of education in promoting sustainable development in the tropics. Available on <http://www.changetropics.org> Accessed on 28.09.07.
- Sherrard D (2003). The change agenda: A new approach to Higher Education in Agriculture. Paper prepared for the EARTH-Salzburg Seminar Series, Sustainability, Education and the Management of Change in the Tropics. Available on <http://www.changetropics.org> Accessed on 28.09.07.

- Munthali D, Mulinge R (eds). Rebuilding Africa's capacity for agricultural development: the role of tertiary education. Nairobi: World Agroforestry Centre (ICRAF).
- Temu AB (2004). Towards better integration of land use disciplines in education programmes. In: Temu AB, Chakeredza S, Mogotsi K, Temu AB, Chakeredza S, Mogotsi K, Munthali, D, Mulinge R (2004). Rebuilding Africa's capacity for agricultural development: the role of tertiary education. Reviewed papers presented at ANAFE Symposium on Tertiary Agricultural Education, April 2003. ICRAF, Nairobi, Kenya. p. 498.
- Temu AB, Mwanje I, Mogotsi K (2003). Improving Agriculture and Natural Resources Education in Africa: A Stitch in Time. Nairobi, Kenya: World Agroforestry Centre (ICRAF), p. 36.
- von Braun J, Swaminathan MS, Rosegrant MW (2004). Agriculture, Food Security, Nutrition and the Millennium Development Goals. 2003-2004 IFPRI Annual Report Essay. Available at http://www.ifpri.org/pubs/books/ar2003/ar2003_essayall.htm Accessed on 26th September, 2007.