Institutional and Governance Framework for Participatory Technology
Enterprise Development in Uganda

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Abstract

Based on comprehensive fieldwork 2001-2010 in Soroti district, Uganda, this paper show how an enabling institutional and governance framework can result in successful agricultural enterprise development with significant production and poverty impact.

List of acronyms

CBOs	Community Based Organisations
CGIAR	Consultative Group for International Agricultural Research
DNC	District NAADS Coordinator
FEWs	Frontline Extension Workers
FFS	Farmer Field School
FID	Farmer Institutional Development
LG	Local Government
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organization
NARS	National Agricultural Research Stations
NG	NAADS farmer groups
NGO	Non Governmental Organisations
NUSAF	Northern Uganda Social Action Fund
PSP	Private Agricultural Service Providers
SCFF	Sub County Farmer Fora
SCNC	Sub Country NAAADS Coordinator
SMS	Subject Matter Specialist
SOCADIDO	Soroti Catholic Diocese Integrated Development Organization
TDSs	Technology Development Sites
TORs	Terms of Reference
ToT	Transfer of Technology
USH	Uganda Shilling

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1.0 Introduction

This study explore why the range of relevant yield improving technologies developed over the past two decades in East and Southern African as a result of demand-driven agricultural research have not become widely spread among smallholder farmers.

Most observers agree that small scale agricultural development hold the potential of being the most effective strategy of reducing rural poverty in Africa (WB 2008). However, there continue to be considerable disagreement over how to stimulate small scale agricultural enterprise development (Diao, X., Hazell, P. and Thurlow, J. 2010). In the last decades of the 20th century the productivity of African agriculture failed to keep pace with the increase in population. This and the increasing frequency and severity of adverse weather has worsened the food security and incomes of millions of rural people. Agricultural research institutions have tended to assume that they understand the farmers' problems and that they can produce technologies that will be readily be disseminated by the extension services to other farmers. However, this pipeline approach has proven incapable of enabling the needed change in the complex and highly divers smallholder and pastoral production systems of Africa.

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During the 1990's agricultural researchers in East and Southern Africa increasingly involved farmers in their work leading to a demand driven research agenda becoming dominant in the 2000's. Economic structural adjustment reforms that had been implemented in most East and Southern African countries by the Mid-1990's accentuated this shift away from the conventional researcher driven pipeline systems, as external seasonal inputs required for many of the conventionally developed technologies offered by this system no longer were economic attractive and viable for small scale farmers as subsidies were eliminated for seasonal inputs (e.g. mineral fertilizer and pesticides) and seed companies privatized and markets liberalized (Friis-Hansen 2000).

Participatory demand-drive research at national agricultural research stations and international agricultural research centers (CGIAR) in the East and Southern African Region resulted in the emergence of a portfolio of technology enterprises that are capable of significantly increasing productivity of smallholder agricultural production. These

technology enterprises are characterized by being cheap to acquire and maintain, reflecting poor farmers demand for more affordable technologies.

However, much to the disappointment of many agricultural researchers, international donor agencies and political leaders, the spread of these well adapted and highly relevant technologies were limited and the speed of spread slow in East and Southern Africa (Egelyng 2005). Spread of the participatory developed portfolio of technologies was largely limited to communities supported by donor financed development programs or within the areas where the researchers had carried out their on-farm trials (Friis-Hansen 2002).

To gain a deeper understanding of why relevant yield improving technologies that holds the potential of reducing rural poverty have not become widely spread among smallholder farmers require a re-thinking of our concept of technology as well as empirical field work that spread light on the institutional reasons for market failure and success.

The paper falls in five sections. Following introduction, section two provide a brief context of smallholder agricultural development in East and Southern Africa. Section three challenges the conventional economic conceptualization of technology and explores the possibilities of developing a different theoretical framework for analyzing participatory technology development, adoption and spread in the context of smallholder farmers in Africa. Section four is a case study successful technology spread in Soroti district, Uganda that is based in depth empirical field work. The case study investigate the institutional mechanism that enable a portfolio of participatory technology spread and by maintained by farmers in a sustainable manner. Finally section five draw conclusions and discuss policy perspectives.

2.0 Smallholder a~~Context of a~~gricultural technology development in Africa

~~Most observers agree that small holder agricultural development hold the potential of being the most effective strategy of reducing rural poverty in Africa. However, there~~

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Improving livelihoods and achieving development will not be possible without yield enhancing technical options because, except in a few areas, it is no longer possible to meet the needs of increasing numbers of people by expanding areas under cultivation and attempting to do so will have serious negative consequences for environmental services such as the provision of fresh water that is an increasingly scarce commodity. There is also virtually no scope for increasing labor inputs because African farmers, especially the women who are responsible for more than their share of farm work in addition to their household functions, are more than fully occupied already. Thus the necessary increases in production must come from the application of new knowledge.

East and Southern Africa is a major area of concentration of rural poverty. While the marginal agro-ecological areas contain the highest proportion of poor people, the majority of the poor in the region live in medium-to-high potential areas. Technically, the productivity, household food security and income of a large proportion of these poor farmers could be substantially higher. Smallholder agriculture has not provided a base for improved livelihood because its potential has not been fulfilled. The performance of the rural poor as producers and traders is dependent upon their access to productive resources (land, labour, technology, capital and productive assets) and their knowledge to use those resources effectively and sustainably.

Smallholders have to explore local, national, regional and international market opportunities to improve their livelihood. Access to external inputs is therefore a necessary element of

increasing smallholders' agricultural production. Access to improved technologies and associated inputs by smallholders have in the past been mediated through institutions such as technology supply companies or parastatals, input suppliers and markets and financial institutions. These institutions have only had limited accountability to the rural population, and have instead been accountable to other groups in the population, with interests distinct from and often in contradiction with, much of the rural population. The nature of these institutions, and the relationship they have with the rural poor, is an essential determinant of the current and future state of rural poverty. Notably, many of the existing institutions in rural areas of East and Southern Africa have not been part of the solution of rural poverty; they have been part of the problem.

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3.0 Theoretical reflections on Participatory Agricultural Technology Development for Smallholder Farmers

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Agricultural technology development interventions in Sub-Saharan Africa have largely been based on an economic and instrumental understanding of technology developed in western industrial societies. This economic approach basically operates with three influential components in technological development; capabilities of science, market demands and the relative market price of production factors. Even though these components are all important, they do not explain the very constitution of technology generation and dissemination processes or why some technologies develop in certain directions instead of others and how technology develops by means of social constructing processes.

Natural and social science agricultural research that supports smallholders' sustainable use of natural resources and improves productivity comprises a crucial component in a strategy for alleviating poverty (Rip and Kemp 1998). However, what constitutes pro-poor technology is one of the most contested issues of the rural development debate and one in which a wide range of opinions exists.

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Many agricultural scientists working in CGIAR and NARS institutions in East and Southern Africa~~ESA~~ have today learned and accepted participatory approaches to technology development. This is however insufficient to ensure technologies that reach the intended beneficiaries. There is thus a growing need to rethink how technologies are being

disseminated and adopted by farmers and the institutional framework supporting such technology development processes. It is becoming increasingly clear that the spread of sustainable technologies among poor farmers is slow and successful examples are often project-based (and therefore associated with considerable indirect of direct subsidies). Pro-poor agricultural technologies that could contribute to agricultural sustainability are only to a limited extent spread through market forces alone. ~~This article book identifies three main sets of issues that limit a market based spread of pro-poor technologies, namely farmer knowledge; farmer institutions; and input supply markets.~~

Development ~~as~~ are ~~-~~pulled by market demands or pushed by scientific innovations. But the very constitution of technology generation and dissemination processes is not dealt with and remains a "black box". Within this conception there is no room for the acknowledgement that different groups of farmers have different technological needs, and poor farmers living in harsh and changing environments need a diversity of technological options. The theory lacks explanations of why some technologies are more adopted among in particular poor farmers than others, and how the definition of relevant problems and the conception of progress vary with different social, economic and locality specific conditions for agricultural production?[i] Poor farmers living in harsh and changing environments need a diversity of technological options to minimize production risk, with open possibilities to make adaptive innovations and self maintenance, as they cannot fully rely on external services (Ponte 2000; Almekindres and Boef 2000). However, harmonisation and strengthening of patent regulation and the globalisation of agricultural input and output markets has led to increased standardisation and will possibly limit the diversity in technological options (Douthwaite 2002). Hence the market pull impact on technology generation among poor farmers is limited.

Economic understanding of technology and technological development is criticised for being simplistic and failing to offer an in depth understanding of the processes and various conditions influencing technological development (Dosi 1982; Leydesdorf 1996; Bijker et al. 1987). However, while the use participatory approaches for need identification and involvement of farmers in technology development has increasingly become standard practices of research stations, a similar institutional change has not yet taken place with regards to technology dissemination. A theoretical replacement of the ToT model for

technology dissemination has only been partially conceptualised and is not widely understood and accepted by stakeholders in East and Southern Africa.

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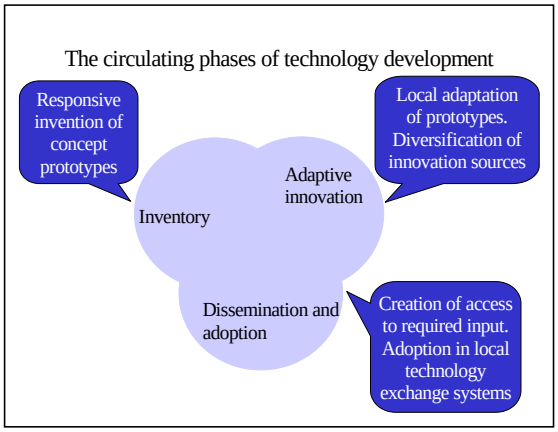
Participatory technology development programmes have implicitly taken for granted, that the new technologies would spread beyond the farmers involved in the technology development processes because of their high adaptation to poor farmers production conditions generated in collaboration with farmers. However, the dissemination of the new technologies is on the one hand blocked by that the structures and functioning of the dissemination systems are based on conventional technology development and adoption theory. On the other hand the theoretical debates associated with participatory technology development have largely been method driven with a focus on refining participatory methods to improve the adaptation of technologies. Left out of the debate has been the constitution of processes of adoption of the new technologies among poor farmers and their institutional implications beyond the farmers involved in participatory research projects. Experiences show that technologies do not spread only as a result of adequate adaptation. Hence, an important corner of the 'black box' still needs lightening before technology generation and dissemination processes among poor farmers is better understood and it becomes possible to identify institutional structures needed to underpin these processes on a national scale.

With an integrated understanding of ~~and~~ participatory approaches to agricultural technology development the processes involved must be conceived as circular rather than linear. As illustrated in figure 1 knowledge, practices and innovative ideas are circulated among farmers, researchers, input suppliers, and extension services providers transferring three phases: (1) The inventory phase mainly conducted by researchers in laboratories and research stations based on input from interaction with farmers and scientific and practical knowledge from farmers fields. As perfect knowledge about poor farmers' needs, practices and preferences in different localities is not available, responsiveness and flexibility must be built into the research programme. (2) The adaptive innovation phase mainly conducted by farmers in their fields based on technology concept prototypes and input of local biological resources and farmers and scientists knowledge and practices. In this phase the prototypes are not only adapted to local production conditions but the generation of innovative ideas are diversified and a broad ranch of knowledge and practical resources are drawn on. (3) The phase of dissemination and adoption of technologies among poor farmers facilitated by local bio-input suppliers, extension services providers and farmers' informal technology exchange systems.

Figure 1: The three circulating phases of agricultural technology development processes.



The conventional technological development approach constitutes a technological trajectory of uniformity in production methods and seasonal inputs with no or little possibilities or anticipated need for further local adaptation by farmers. This has proven to be inadequate under poor farmers' production conditions, in particular for those who are producing in areas with significant variation over time and space in agronomic stresses and social and economic conditions for agricultural production. These farmers are demanding diversity in methods and organisation of production to manage a flexible damage control (ex. from crop production Ceccarelli et al. 2001; Almekinders/Boef 2000).

The pro-poor participatory technology development approach tries to move from a centralised development of finished technologies and inputs to decentralised development of prototypes, which can be modified and adapted by farmers. However, to exploit the diversity of innovation potentials among farmers, their adaptive innovation for improving and finishing the prototypes needs to be encouraged and underpinned with knowledge and capacities. Researchers and providers of agricultural services and inputs need to be involved to fill the knowledge gabs but also to learn new experiences to draw on in the development of

improved or new prototypes, services and physical and biological inputs. As Douthwaite (2002) puts it:

"*'Finishing' a technology requires innovation, particular organisational ones, that can only be made by farmers when they adopt the technology for real – in other words when they have invested their hard-earned cash and they are committed to make it work*"

The challenge is to encourage in particular poor farmers to make this investment and gain their commitment. The demanding adaptive innovation phase will only appeal to and be in the reach of a certain group of farmers who are motivated, prepared to take risks, will enjoy the challenges of making technology work, and are likely to be technically proficient. But what are institutional and governance structures can facilitate such participatory technology development processes and ensure wide dissemination and adoption of the new technologies among poor farmers?

Participatory technology development approach generates technologies based on better use of local knowledge and use of biological resources, which tend to be more complex and knowledge demanding to manage. The need of a more efficient use of local bio-resources and knowledge to avoid dependency of high level of expensive external inputs requires the application of biological principles, which in nature are more complex. Hence the knowledge generation in context among farmers in relation to the application of the technologies becomes very crucial. However, this may not be true for all the new technologies, thus it is important to consider how different technologies demands different knowledge generation processes among poor farmers, researchers and extension services providers.

Using the model illustrated in figure 1, we may distinguish between two stages/forms of farmer knowledge required for dissemination of pro-poor participatory agricultural technology: (i) the generation of new knowledge to improve conception prototypes and adaptive innovation based on combining scientists' and farmers' knowledge and practices by experimentation in farmers fields and (ii) the generation of knowledge among farmers enabling them to incorporate the new flexible technologies in local production systems.

Hence the participatory technology development processes must take place in two stages/levels: (i) the generation of new knowledge to improve technologies and produce

proto-types based on combining scientists' and farmers' knowledge and practices by experimentation in farmers fields and (ii) the generation of knowledge among farmers to enable them to adapt the new prototypes to local production conditions.

However, the existing system and commercial market structures for input production and supply is not constructed to reach poor farmers and to handle these new inputs in terms of institutional structures, legislation and organisation. To provide the inputs needed for the new technologies and secure poor farmers access, community-based productions of bio-inputs like seeds, manure, bio-pesticides, bio-predators etc. must be created. The challenge is to identify how this can be organised and test if it is possible to create such decentralised community based bio-input productions and local markets in a sustainable manner.

4. Participatory technology development and spread in Soroti District, Uganda

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Prior to the advent of NAADS in 2001 in Soroti the existing conventional agricultural advisory systems had failed to achieve effective dissemination and sustainable development and adoption of technologies among resource poor farmers in the district. The recent reforms in the agricultural advisory services in Uganda have however, enabled devolution of authority over financial and human resources and decision-making with regards to prioritizing technology development to farmer institutions at the sub-district (sub-county, Parish and group) level. A new method has emerged in which needs are assessed through a dialogue that take place between farmers, service providers, politicians, community leaders and private service providers through a system of stepwise consultative meetings beginning with farmer groups at village level to parish and sub county. This has led to the development of well considered and viable technologies that have caused significant rural transformation in the district. Farmers have become agents rather than objects of planning and this has built ownership and trust among stakeholders in the PTD and enterprise promotion process.

Development of farmer institution under NAADS has contributed dramatically to the adoption and spread of agricultural technologies. Prior to the program in 2001, agricultural production in Soroti district was dominated by smallholder subsistence farmers who cultivated food crop and reared cattle using traditional farming practices serviced by top-down agricultural extension services. Products were often of poor quality and only smaller

proportions were marketed. There were widespread mistrust within local communities and farmers were not organized to efficiently access inputs and or market their produce collectively. They thereby incurred high production and transaction costs, which affected the profitability levels in their enterprises

The NAADS technology enterprise development strategy has provided an institutional framework that stimulates an informed dialogue between demand and supply driven approaches. The enabling institutional frameworks for technology and enterprise development in Soroti takes point of departure in the farmers' institutional governance structures at group, Parish and sub country level. Other actors include DNC, SCNC, PSP, NGOs, technical staff from LG production department (subject matter specialists and frontline extension workers), NARO researchers and LG representatives.

The Farmer Forum at Sub County ensure that the service providers they contract provide knowledge that is relevant to their identified constraints and that interventions are within their financial capacity and their local resource base. The FID process has developed a dialogue between technical teams and farmers in a way that increase farmers understanding of their situation and to use it to evaluate the viability of different technology options available at research level to generate appropriate interventions to change their current situations. The dialogue conducted at village level involves facilitators setting the agenda and defining the issues and using simple tools and their knowledge, help the farmers identify underlying constraints associated with all potential enterprises in the village that they can adopt to quickly change their lives. With participants taking the lead, they then come up with suitable strategies and technologies to use in developing prioritized crops and livestock into commercial enterprises. The benefits of this dialogue is that the participants transfer their local knowledge to the facilitators while the facilitators convey not only participatory skills but also theoretical frameworks and comparative information which help the farmers analyze the local situation in a systems context with profitability and marketability given high scores. However where farmers are highly differentiated by land, financial and skills capabilities the dialogue allows farmers to negotiate options that are feasible to them.

The needs prioritized at village and parish levels are consolidated at the sub county using a ranking system that is quite democratic but may well leave out a host of minority views that may have come from below. The process at Sub County is facilitated by the PSP in charge of

FID (NGO) supported by subject matter specialists. Effective facilitation is required at this level to ensure that the farmers are not disempowered and frustrated by having their priorities left out. The SCFF, NGOs, district SMS Researchers, LC representatives are the key functionaries in these meeting. Parish representatives that participated in the needs assessment at that level are also sent by the villagers to verify and ensure their priorities are not altered. The role of the research representative is to tease out the salient researchable constraints that may have been articulated by the farmers in the Enterprise Selection process. Minority issues are all consolidated and TDSs are set up to address them in the groups that prioritized them. If the minority issues are wide enough to warrant bigger attention, the sub county may sign technology development contracts to not only demonstrate the associated technologies but also begin to promote them on a wider scale that may enable them become priority enterprises in the subsequent years. The development of citrus in Soroti which is now a major enterprise of national concern in took this route.

The efficiency with which selected enterprises, associated technology advisory services interventions are converted into TORs and service contracts is the key test that may derail the technology and enterprise development process. Subject matter specialists at district working with FEWs at the sub county analyze all the constraints mentioned by farmers at village and parish level and convert them into TORs for service delivery and specifications for the technology inputs that will be required in the service and supply contracts. The TORs must be presented to the procurement and executive committee of the farmers forum for approval before any advertising is done. This is a crucial safeguard to assure compliance to the issues in the enterprise selection process of the enterprise selection process.

Arising from the sub county needs assessment processes the district realize the strategic importance of common enterprises that are cross cutting at sub county level. The sub counties on their own are not able to fund these enterprises that may have the technical and financial requirements well above their capacity. The citrus production and beekeeping have been promoted under this level. The district has also collaborated with other agencies to fund strategic enterprises to meet their specific development demands at the sub county.

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NAADS has provided technology development funds at the sub county that initially amounted to 60% of the sub county budget. The sub county technology funds are used to procure goods and services that address the technology needs arising from constraints

identified in the participatory needs assessment process at farmer level. Beneficiaries to these are the farmer groups who are selected to host TDSs. The PSP set up the TDSs in line with the terms of reference and designs agreed with the farmer forum assisted by the subject matter specialists and FEWs. The facilitation of the learning process at the TDS is guided by outputs in the TOR of the contract but depend on the extension method of the PSP.

Technology development contracts have been widely used in Soroti to ensure the local availability of cheap biological inputs. These are crucial to the sustainable adoption of technologies. The farmer institutions ensure that PSPS establish decentralized units for production of biological based inputs required to sustainable spread of selected enterprises. The forum innovated technology development contracts that demonstrate, adapt and multiply biological inputs that are cheap but usually unattractive to commercial inputs dealers due to their bulk and additional technical requirements at farm level. These include vegetative planting materials such as orange seedlings, root crops planting materials and improved livestock breeds.

The Technology Development contract is a comprehensive contract that includes the full package of inputs, and other goods and services required in the development of a particular technology. The role of the service provider is to purchase, and establish TDSs as well as train farmers on the technologies being developed. In Soroti, this was the most common type of contracting that was found to be very suitable for long term technology demonstrations such as fruits and livestock that require. Although this system was contested in and 2004 and was abandoned as procurement rules dictated separate contract for goods and for services enough infrastructure had been developed to sustain the successful development of groundnuts citrus and poultry and beekeeping, livestock enterprises in the district. The technology development contract had the advantage that the service provider by being in charge of all processes is holistically accountable to the technology package (quality of the goods and services he is promoting) unlike in a case where the goods would be supplied by someone else.

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From 2001 when NAADS was first introduced, technology enterprise development in Soroti has taken several patterns. The main trends in ES have been the focus on over 10 types of enterprises district wide to a convergence of priorities on a few profitable enterprises for the district. Enterprise selection is governed by profitability and marketability of the enterprise

but over the years, the farmers have included the effects of climate change as a major consideration. The demand by politicians for visibility of enterprises on the ground as evidence of NAADS performance has also helped to shape enterprise selection and development considerations towards the less weather risky and longer term enterprises. The study however shows that there is a wise mix of short and long term enterprises being adopted by farmers in combinations that help to meet the farmers' short and long term financial requirements.

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The Citrus Enterprise: an Example of PTD involving Farmer Institutions.

The citrus development in Soroti is a story of how technologies involving cheap biological inputs of high value enterprises can be successfully domesticated by small scale farmers. Production of oranges was introduced in Soroti by government in the early 1970 as part of a major scheme to promote irrigation. However never before had it become a viable enterprise due to its skill intensive propagation methods. Odina citrus scheme in Soroti that covers 1000 acres was planted with irrigated citrus. However in 1977 the Israeli consultants that managed the farm left the country and the scheme got vandalized thereafter in the civil strife that befell the area. The farmers around the scheme and others in Asuret and Kamuda as well as government institutions such as Arapai College and Serere research station had however set up small orchards from plantlets donated by the Israeli experts. These however consisted of some very good improved varieties.

The first sub counties to identify the crop in their enterprise selection process in 2002 were Asuret and Kamuda. The key constraints identified by SCFF were availability of planting materials and the control of pest and diseases. SCFF in both sub county advertized tender for technology development contracts to set up TDSs and trained farmers on nursery establishment and budding and grafting techniques for production of seedlings. A PSP company called RIDA that is made up by former FFS facilitators, won both contracts. They subsequent set up a number of TDS using a farmer field school approach, rather than the standard TDS model.

The establishment of citrus nurseries and training of members of NAADS groups were highly successful. RIDA accessed parent stock of Citrus from Arapai Agricultural College and from individual farmers adjacent to the now defunct Odina citrus scheme. Participating farmers

were asked to collect wild growing local lemon stems for grafting or budding. The use the FFS approach, including agro ecosystem analysis, allowed participating farmers to experiment with budding versus grafting, revealed that budding was much more appropriate for their situation.

Citrus is not a labour intensive enterprise and apart from specific period, e.g. weeding, pruning, spraying and harvesting, engagement in citrus may not necessarily take away farmers time from other farming talks. The key input demand is for the planting material. However, given the system of establishing a TDS in each group, all group members have access to sufficient seedlings to start their own farm. While somehow demanding in terms of knowledge and skills, most farmers involved with the FFS based training provided by RIDA seemed able to adopt citrus on their own farm. The biggest constraint for adopting citrus during the first years after its introduction in 2002, was the four years time lack between investment and the first result in terms of mature oranges. The seems to have discouraged many, in particular very poor farmers, for who fast return to investment is more important than a potentially larger return to investment.

While most of the seedlings produced by the first TDS in were Asuret and Kamuda subcounties were distributed to members of associated NAADS gropps, the surplus was bought and distributed to other FGs through contract by the sub county farmer fora.

Meanwhile the NAADS secretariat in Kampala because under political pressure from government of Uganda to show visible results. They send out requests to all district in which NAADS operated, to rapidly scale up the two most promising technology enterprises. Naads Soroti chose citrus to be one of them and granted RIDA a district wide technology development contract to set up 2-3 nurseries in each Parish for mass producing of citrus seedlings using the budding technique. This effort was supported by the Naads Secretariat that had contracted NARO to send seedlings of several different citrus varieties to NAADS Soroti, who handed them on to RIDA.

In subsequent years, citrus was chosen as technology enterprise by SCFF in the rest of Soroti district. The possibility was introduced by SCNC and farmers knew about it through organized and informal intra-district visits by SCFF members. However, it was only when

the first trees mature and produced sweet oranges that fetched high prices on easily available markets, that the spread of citrus dramatically increased.

The NAADS intervention since 2001 has been to increase the availability of planting materials so as to increase the production of the crop. The key skills required to be imparted to farmers were, nursery establishment and propagation of planting materials, basically budding techniques. Service providers set up community nurseries at TDS level and trained farmers on nursery management and budding.

With the increased demand for budded citrus seedlings, some young farmers began specializing in producing seedling only. At TDS level farmers are able to raise an average of 2,000 seedlings per year valued at 4 milion USH. Farmers that specialize in production and sale of budded citrus seedlings, buy up seedlings of lemons from other farmers and specialize in budding only.

Box 1: Economics of citrus production

At TDS level, each of the 10 members may take 200 seedlings each from the group and plant oranges in orchards. They can sell as fruits in 4 years. Average yield is 400 bags (120 kg) for 200 trees. Each bags will fetch 20.000/= equal to 8 million shillings. This income stream may continue for 20-30 years Farmers who specialize in seed production may buy up to 10,000 seedlings and hire skilled labor to bud for them at 200 Ush per plant. Notably, the rough lemon seeds used as rootstocks are almost free. Only recently it has begun to sell on market for less than 10000 ush for 2000 seeds. Production cost for buying seedlings, budding and maintenance of 5 nurseries is approximately 2 million USH. The budded seedlings will sell for estimated 20 million USH.

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By 2007 the demand for seedlings had spread to the whole of Teso region and elsewhere in Uganda, with some planted 5 million trees. New varieties such as Mineola, tangerine, frost tangerine, Jerusalem Navel, sweet Mediterranean has been introduced in TDS to meet new demands. The majority of the seedlings are bought by NGOs and CBOs and SCFF for expanding citrus as technology enterprise. Government also promotes the crop as a regional poverty alleviation strategy.

The production impact is that, the area cultivated with citrus increased from 50 acres in 2001 to 1200 acres in 2005. The market is continuously increasing as demand for fresh oranges has extended to northern Uganda, Southern Sudan, Rwanda and Northern Kenya. There are limited marketing cost, as buyers buy in bulk directly from nursery. Much of the product is sold out of the district. It is estimated that 4 kg oranges will produce 1 liter of juice, which when sold at 2.000 USH/ per liter, the value edition would potentially triple farmer' income from citrus growing.

Many strategies have been employed in Soroti district to develop sustainable markets for proven biologically based technology inputs. The forum has been instrumental in the strategic establishment of TDSs that have been learning points for technologies as well as centers for multiplication and access to technology inputs. These strategies sometimes required additional investments from outside the communities that were achieved through effective lobby based on results on the ground.

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Other Options for Financing Enterprise Development:

i) District Technology fund

The district technology fund is meant to promote district wide technology options than may be relevant beyond the sub county as a unit. The Soroti district fund was sued to promote citrus and honey production through acquisition and introduction of technologies associated with those enterprises. The district also used the fund to promote processing and value addition for the emerging HLFOs. The funding was first accessed to a few districts that had developed farmer groups into commodity associations. These groups had unique demands that could not be handled by their respective sub counties.

Collaboration with NAADS Secretariat for Dairy and Fish Farming

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In the process of enterprise development, there came a need for national level support for technologies the costs of which were beyond Soroti district. The demands were of strategic importance and had potential regional benefits. This was developed into enterprise promotion proposals with clear technology development segments identified for financing. The establishment of the Dairy plant and the fish fry centre in Kikota in Serere are some of the examples of these interventions.

The second area of collaboration arose as an instructive policy arrangement which required each district to identify 2 enterprises for promotion to commercial levels. This arose from the pressure from politicians that contested the visibility and therefore the performance of NAADS and its impact on the ground. The further support to up scale citrus technology demonstration sites and introduction of new varieties as well as support to commercial community nurseries was a result of this intervention. The key actors in this are subject matter specialists working with contracted PSPs. The end result of this has been the creation of nucleus farms that are a source of technology inputs and centers for bulk marketing of technology products.

Collaboration with other programs

NAADS in Soroti collaborates with a number of development agencies to scale proven technologies. The collaboration may take the form of a formal collaboration agreement as with NUSAF, or joint planning as with SOCADIDO or informal understanding at the sub country and project level. The NUSAF program collaboration involved the use of NAADS to offer advisory services for vulnerable group support (VGS) projects that involved beekeeping, Bull schemes and crop production initiatives. In each case the farmers registered with NAADS at the sub county and benefited from normal NAADS advisory services for services such as beehive inspection and honey processing, heat detection in cows, citrus nursery management etc. NAADS also collaborated with NUSAF in establishing and functionalizing the dairy plant in Gweri.

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~~*Participatory governance of smallholder agricultural technology development: the case of Soroti district, Uganda*~~

~~Local government and extension reforms in Uganda have devolved authority over financial and human resources and decision-making with regards to prioritizing technology development to farmer institutions at the sub-district (sub-county, Parish and group) level. A new method has emerged in which needs are assessed through a dialogue that take place between farmers, service providers, politicians, community leaders and private service providers through a system of stepwise consultative meetings beginning with farmer groups at village level to parish and sub-county.~~

The effective management of this participatory governance to technology development processes, in Soroti has led to the development of well considered and viable technologies that have caused significant rural transformation in the district. Farmers have become agents rather than objects of planning and this has built ownership and trust among stakeholders in the PTD and enterprise promotion process.

Development of farmer institution under NAADS has contributed dramatically to the adoption and spread of agricultural technologies. At the introduction of the program in 2001, agricultural production in Soroti district was dominated by smallholder subsistence farmers who cultivated food crop and reared cattle using traditional farming practices. Products were often of poor quality and only smaller proportions were marketed. There were widespread mistrust within local communities and farmers were not organized to efficiently access inputs and or market their produce collectively. They thereby incurred high production and transaction costs, which affected the profitability levels in their enterprises

The NAADS technology enterprise development strategy has provided an institutional framework that stimulates an informed dialogue between demand and supply driven approaches. The enabling institutional frameworks for technology and enterprise development in Soroti takes point of departure in the farmers' institutional governance structures at group, Parish and sub country level. Other actors include DNC, SCNC, PSP, NGOs, technical staff from LG production department (subject matter specialists and frontline extension workers), NARO researchers and LG representatives.

Technology development Strategy

The FID has developed a dialogue between technical teams and farmers in a way that increase farmers understanding of their situation and to use it to evaluate the viability of different technology options available at research level to generate appropriate interventions to change their current situations. The dialogue conducted at village level involves facilitators setting the agenda and defining the issues and using simple tools and their knowledge, help the farmers identify underlying constraints associated with all potential enterprises in the village that they can adopt to quickly change their lives. With participants taking the lead, they then come up with suitable strategies and technologies to use in developing prioritized crops and livestock into commercial enterprises. The benefits in this dialogue is that the

participants transfer their local knowledge to the facilitators while the facilitators convey not only participatory skills but also theoretical frameworks and comparative information which help the farmers analyze the local situation in a systems context with profitability and mmarketability given high scores. However where farmers are highly differentiated by land , financial and skills capabilities the dialogue allows farmers to negotiate options that are feasible to them.

The needs prioritized at village and parish levels are consolidated at the sub county using a ranking system that is quite democratic but may well leave out a host of minority views that may have come from below. The process at Sub County is facilitated by the PSP in charge of FID (NGO) supported by subject matter specialists. Effective facilitation is required at this level to ensure that the farmers are nor disempowered and frustrated by having their priorities left out. The SCFF, NGOs, district SMS Researchers, LC representatives are the key functionaries in these meeting. Parish representatives that participated in the needs assessment at that level are also sent by the villager to verify and ensuire their priorities are not altered. The role research representative is to tease out the salient researchable constraints that may have been articulated by the farmers in the ES process. Minority issues are all consolidated and TDSs are set up to address them in the groups that prioritized them. If the minority issues are wide enough to warrant bigger attention, the sub county may sign technology development contracts to not only demonstrate the associated technologies but also begin to promote them on a wider scale that may enable them become priority enterprises in the subsequent years. The development of citrus in Soroti which is now a major enterprise of national concern in took this route.

Conversion of Priorities TORs and Contracts

The efficiency with which selected enterprises, associated technology advisory services interventions are converted into TORs and service contracts is the key test that may derail the technology and enterprise development process. Subject matter specialists at district working with FEWs at the sub county to analyze all the constraints mentioned by farmers at village and parish level and to convert them into TORs for service delivery and specifications for the technology inputs that will be required in the service and supply contracts. The TORs are presented to must be presented to the procurement and executive committee of the farmers

forum for approval before any advertising is done. This is a crucial safeguard to assure compliance to the issues in the enterprise selection process of the enterprise selection process

Arising from the sub county needs assessment processes the district realize the strategic importance of common enterprises that are cross cutting at sub county level. The sub counties on their own are not able to fund these enterprises that may have the technical and financial requirements well above their capacity. The citrus production and beekeeping have been promoted under this level. The district has also collaborated with other agencies to fund strategic enterprises to meet their specific development demands at the sub county.

NAADS has provided technology development funds at the sub county that initially amounted to 60% of the sub county budget. The sub county technology funds are used to procure goods and services that address the technology needs arising from constraints identified in the participatory needs assessment process at farmer level. Beneficiaries to these are the farmer groups who are selected to host TDSs. The PSP set up the TDSs in line with the terms of reference and designs agreed with the farmer forum assisted by the subject matter specialists and FEWs. The facilitation of the learning process at the TDS is guided by outputs in the TOR of the contract but depend on the extension method of the PSP.

Technology Development Contracts

This involves signing a comprehensive contract with a service provider that includes the full package of inputs, and other goods and services required in the development of a particular technology. The role of the service provider is to purchase, and establish TDSs as well as train farmers on the technologies being developed. In Soroti, this was the most common type of contracting that was found to be very suitable for long term technology demonstrations such as fruits and livestock that require. This system was contested in and 2004 and was abandoned as procurement rules dictated separate contract for goods and for services. The successful development of groundnuts citrus and poultry and beekeeping, livestock enterprises in Soroti district is attributed to this modality.

The technology development contract had the advantage that the service provider by being in charge of all p processes is holistically accountable to the technology package (quality of the

goods and services he is promoting) unlike in a case where the goods would be supplied by someone else.

District technology fund

The district technology fund is meant to promote district wide technology options than may be relevant beyond the sub county as a unit. The Soroti district fund was sued to promote citrus and honey production through acquisition and introduction of technologies associated with those enterprises. The district also used the fund to promote processing and value addition for the emerging HLFOs. The funding was first accessed to a few districts that had developed farmer groups into commodity associations. These groups had unique demands that could not be handled by their respective sub counties.

Collaboration with NAADS Secretariat

In the process of enterprise development, there came a need for national level support for technologies the costs of which were beyond Soroti district. The demands were of strategic importance and had potential regional benefits. This was developed into enterprise promotion proposals with clear technology development segments identified for financing. The establishment of the Dairy plant and the fish fry centre in Kikota in Serere are some of the examples of these interventions.

The second area of collaboration arose as an instructive policy arrangement which required each district to identify 2 enterprises for promotion to commercial levels. This arose from the pressure from politicians that contested the visibility and therefore the performance of NAADS and its impact on the ground. The further support to up scale citrus technology demonstration sites and introduction of new varieties as well as support to commercial community nurseries was a result of this intervention. The key actors in this are subject matter specialists working with contracted PSPs. The end result of this has been the creation of nucleus farms that are a source of technology inputs and centers for bulk marketing of technology products.

Collaboration with other programs

NAADS in Soroti collaborates with a number of development agencies to scale proven technologies. The collaboration may take the form of a formal collaboration agreement as with NUSAF, or joint planning as with SOCADIDO or informal understanding at the sub country and project level. The NUSAF program collaboration involved the use of NAADS to offer advisory services for vulnerable group support (VGS) projects that involved beekeeping, Bull schemes and crop production initiatives. In each case the farmers registered with NAADS at the sub-county and benefited from normal NAADS advisory services for services such as beehive inspection and honey processing, heat detection in cows, citrus nursery management etc. NAADS also collaborated with NUSAF in establishing and functionalizing the dairy plant in Gweri.

Patterns of Technology enterprise development in Soroti

From 2001 when NAADS was first introduced, technology enterprise development in Soroti has taken several patterns. The main trends in ES have been the focus on over 10 types of enterprises district wide to a convergence of priorities on a few profitable enterprises for the district. Enterprise selection is governed by profitability and marketability of the enterprise but over the years, the farmers have included the effects of climate change as a major consideration. The demand by politicians for visibility of enterprises on the ground as evidence of NAADS performance has also helped to shape enterprise selection and development considerations towards the less weather risky and longer term enterprises. The study however shows that there is a wise mix of short and long term enterprises being adopted by farmers in combinations that helps to meet the farmers' short and long term financial requirements.

The sub section below describes the origin evolution of different enterprises in Soroti district and the interventions that have led to their development in the district.

Development of Citrus enterprise

Enterprise selection of citrus

Production of oranges was introduced in Soroti by government in the early 1970 as part of a major scheme to promote irrigation. Odina citrus scheme in Soroti that covers 1000 acres was

planted with irrigated citrus. However in 1977 the Israeli consultants that managed the farm left the country and the scheme got vandalized thereafter in the civil strife that befell the area. The farmers around the scheme and others in Asuret and Kamuda as well as government institutions such as Arapai College and Serere research station had however set up orchards that contained some very good improved varieties.

The first sub counties to identify the crop in their enterprise selection process in 2002 were Asuret and Kamuda. The key constraints identified by SCFF were availability of planting materials and the control of pest and diseases. SCFF in both sub county advertized tender for technology development contracts to set up TDSs and trained farmers on nursery establishment and budding and grafting techniques for production of seedlings. A PSP company called RIDA, that is made up by former FFS facilitators, won both contracts. They subsequent set up a number of TDS using a farmer field school approach, rather than the standard TDS model.

The establishment of citrus nurseries and training of members of NG were highly successful. RIDA accessed parent stock of Citrus from Arapai Agricultural College and from individual far adjacent to the now defunct Odina citrus scheme. Participating farmers were asked to collect wild growing local lemon stems for grafting or budding. The use the FFS approach, including agro ecosystem analysis, allowed participating farmers to experiment with budding versus grafting, revealed that budding was much more appropriate for their situation.

Citrus is no a labour intensive enterprise and apart of specific period, e.g. weeding, pruning, spraying and harvesting, engagement in citrus may not necessarily take away farmers time from other farming talks. The key input demand is for the planting material. However, given the system of establishing a TDS in each group, all group members have access to sufficient seedlings to start their own farm. While somehow demanding in terms of knowledge and skills, most farmers involved with the FFS based training provided by RIDA seemed able to adopt citrus on their own farm. The biggest constraint for adopting citrus during the first years after its introduction in 2002, was the four years time lack between investment and the first result in terms of mature oranges. The seems to have discouraged many, in particular very poor farmers, for who fast return to investment is more important than a potentially larger return to investment.

While most of the seedlings produced by the first TDS in were Asuret and Kamuda subcounties were distributed to members of associated NG, the surplus was bought and distributed to other FGs through contract by the sub county farmer fora.

Meanwhile the NAADS secretariat in Kampala because under political pressure from government of Uganda to show visible results. They send out requests to all district in which NAADS operated, to rapidly scale up the two most promising technology enterprises. Naads Soroti chose citrus to be one of them and granted RIDA a district wide technology development contract to set up 2-3 nurseries in each Parish for mass producing of citrus seedlings using the budding technique. This effort was supported by the Naads Secretariat that had contracted NARO to send seedlings of several different citrus varieties to NAADS Soroti, who handed them on to RIDA.

In subsequent years, citrus was chosen as technology enterprise by SCFF in the rest of Soroti district. The possibility was introduced by SCNC and farmers knew about it through organized and informal intra-district visits by SCFF members. However, it was only when the first trees mature and produced sweet oranges that fetched high prices on easily available markets, that the spread of citrus dramatically increased.

The NAADS intervention since 2001 has been to increase the availability of planting materials so as to increase the production of the crop. The key skills required to be imparted to farmers were, nursery establishment and propagation of planting materials, basically budding techniques. Service providers set up community nurseries at TDS level and trained farmers on nursery management and budding.

With the increased demand for budded citrus seedlings, some young farmers began specializing in producing seedling only. At TDS level farmers are able to raise an average of 2,000 seedlings per year valued at 4 milion USH. Farmers that specialize in production and sale of budded citrus seedlings, buy up seedlings of lemons from other farmers and specialize in budding only.

Box 1: Economics of citrus production

At TDS level, each of the 10 members may take 200 seedlings each from the group and plant oranges in orchards. They can sell as fruits in 4 years. Average yield is 400 bags (120 kg) for 200 trees. Each bags will fetch 20.000/= equal to 8 million shillings. This income stream may continue for 20-30 years

Farmers who specialize in seed production may buy up to 10,000 seedlings and hire skilled labor to bud for them at 200 Ush per plant. Notably, the rough lemon seeds used as rootstocks are almost free. Only recently it has begun to sell on market for less than 10000 ush for 2000 seeds. Production cost for buying seedlings, budding and maintenance of 5 nurseries is approximately 2 million USH. The budded seedlings will sell for estimated 20 million USH.

By 2007 the demand for seedlings had spread to the whole of Teso region and elsewhere in Uganda, with some planted 5 million trees. New varieties such as Mineola, tangerine, frost tangerine, Jerusalem Navel, sweet Mediterranean has been introduced in TDS to meet new demands. The majority of the seedlings are bought by NGOs and CBOs and SCFF for expanding citrus as technology enterprise. Government also promotes the crop as a regional poverty alleviation strategy.

Production impact. The area cultivated with citrus increased from 50 acres in 2001 to 1200 acres in 2005. The market is continuously increasing as demand for fresh oranges has extended to northern Uganda, Southern Sudan, Rwanda and Northern Kenya. There are limited marketing cost, as buyers buy in bulk directly from nursery. Much of the product is sold out of the district. It is estimated that 4 kg oranges will produce 1 liter of juice, which when sold at 2.000 USH/ per liter, thevalue edition would potentially triple farmer' income from citrus growing.

5.0 Conclusion

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The study set out to explore relevant technologies developed using participatory demand-driven research approaches were not more adopted and used more widespread among small scale farmers in East and Southern Africa.

Agricultural research in East and Southern Africa has changed paradigm during the past two decades towards embracing principles of demand driven and participatory research approaches into mainstream research activities. This enhanced responsiveness to the context of resource poor farmers resulted in the emergence of a portfolio of relevant technologies that minimized the need for expensive external seasonal inputs. This is achieved by applying two key principles: (i) Seasonal use of industrial produced inputs (mineral fertilizer and pesticides) are replaced by appreciation of advanced ecological principles (Integrated Soil Fertility Management ISFM and Integrated Pest Management IPM); and (ii) Seasonal use of purchased improved (hybrid) seeds and planting material is replaced by decentralized produced improved seeds.

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During the review of theoretical concepts of technology we identified three main sets of issues that limit a market based spread of pro-poor technologies, namely farmer knowledge; input supply markets; and farmer institutions.

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The Uganda case study shows that most of the technologies in the portfolio emerging from a participatory technology dialogue and successfully spread among smallholder farmers are knowledge intensive. A key policy lesson is that a national reform of advisory services using principles of demand driven advisory services is essential for wide spread adoption of relevant technologies among small scale farmers.

The existing system and commercial market structures for input production and supply is not constructed to reach poor farmers and to handle these new inputs in terms of institutional structures, legislation and organisation. To provide the inputs needed for the new technologies and secure poor farmers access, community-based productions of bio-inputs like seeds, manure, bio-pesticides, bio-predators etc. must be created. The challenge is to identify how this can be organised to create such decentralised community based bio-input productions and local markets in a sustainable manner. The Uganda case study showed that it is possible to develop viable farmer governed units that produce biological based inputs required for sustainable management of technology enterprises. The Uganda case further showed that such units can over time become small private business in the own right.

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Finally the Uganda case study show that it is possible to create and enabling environment for smallholder agricultural technology development and spread that is governed by legitimate

farmer institutions. This ~~The overall emerging patterns of technology development in Soroti has hinged on the~~ enabling institutional and governance environment was created by ~~the NAADs program~~ devolution of power resulting from decentralization and extension service reforms that has allowed direct participation of farmers in (i) a ~~the~~ demand articulation process during the prioritization of ~~-~~existing production constraints; and (ii) ~~-and proposing the possible~~a technology dialogue between (relative) equal partners~~ies~~ to address ~~them~~identified priorities. This dialogue has built a sense of ownership ~~-~~and pride to technology outcomes. ~~Although this may look simplistic, it~~ Farmers' governance of the technology development process is crucial, as it is ~~in guaranteeing~~ enabling farmers ~~own~~ to organize and make investments in local multiplication of the biological based inputs that are required for processes of technology enterprise development, adoption and ~~enterprise development process~~spread.

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~~***An analysis of the enterprise selection process in Soroti depicts increasing efforts to go beyond the NAADS enterprise selection criteria into more protracted farmer led debates that have resulted into a good mix of long and short term enterprises that have stabilized income streams in the district***~~

~~***A major role has been played by the Farmer Instititutional Development efforts by NGOs that has fed into the development of Terms of reference for contracting advisory services. This similarly enshrined the farmers own participation in the designing of contracts to private service providers, the outcomes of which are owned by them.***~~

~~***Another observable institutionally motivated development process is the prioritization establishment of strategic enterprises at the district level largely through the efforts of the district farmers forum. Such enterprises have included citrus, honey and fish culture. These are rather long term initiatives that would otherwise not be adequately supported at the sub county level.***~~

~~***The NAADS in Soroti has also exclusively successful in collaboration with the secretariat in kampala in establishing community level assets that has the potential to serve a wider community than is possible at the group level. This has involved milk cooling plants, root processors, and water facilities for fish fry production. The initiatives have combined the effects of the pull and push technology development strategies with farmer participation.***~~

References

Diao, X., Hazell, P. and Thurlow, J. 2010. The Role of Agriculture in African Development. World Development Vol. 38, No. 10, pp. 1375–138.

Dosi, G. (1982): "*Technological paradigms and technological trajectories" i "Research Policy*". No. 11 1982 pp. 147-162. North-Holland Publishing Company.

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Douthwaite, B. (2002): "*Enabling Innovation. A practical guide to understanding and fostering technological changes*". Zed Books Ltd. London.
Leydesdorf 1996;

Bijker, W. E. et al. ed.(1987): "*The Social Construction of Technological Systems. New Directions in the Sociology and History of Technology*". The MIT Press. London.

Rip, A. & Kemp, R. 1998. Technological change. In S Rayner and E L Malone (eds) *Human choice and climate change: vol II Resources and Technology*. Battelle Press, Cloumbus, Ohio,. P 327-399.

Ponte, S. (2000): "*Policy Reforms, Market Failures and Inputs Use in African Smallholder Agriculture*". European Journal of Development Research.

Almekinders, C. and Boef, W. ed. (2000): "*Encouraging Diversity. The conservation and development of plant genetic resources".* Intermediate Technology Publications. London.

Almekinders, C. and Elings, A. (2001): "*Collaboration of farmers and breeders: Participatory crop improvement in perspective*". In "*Euphytica*". Vol.122, No. 3, pp. 425-438, 2001. Kluwer Academic Publishers. The Netherlands.

Ceccarelli, S. et al. (2001): "*Farmer Participation in Barley Breeding in Syria, Morocco and Tunesia*". In "*Euphytica*". Vol.122, No. 3, pp. 521-536, 2001. Kluwer Academic Publishers. The Netherlands.

Friis-Hansen, E. and Sthapit, B. (2000): "*Participatory Approaches to Conservation and Use of Plant Genetic Resources*". CDR Denmark and IPGRI Italy.

Friis-Hansen, E. (ed) 2000. *Agricultural Policy in Africa after Adjustment*. Copenhagen: CDR.

Friis-Hansen, E. and Boesen, J. 2001. *Agricultural Technology and Poverty Research Programme. Socio-economic Constraints and Opportunities for Generation and Dissemination of new Technology among Poor Farmers*. Copenhagen: Centre for Development Research.

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