Adoption of Improved Fallows in the Nyando Basin, and Lessons from Eastern Kenya

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Summary

Approaches to improved fallows and N-fixing herbaceous and fodder species in the Nyando Basin have been disappointing. Short-term fallows might therefore be inadequate to rehabilitate the severely degraded soils in Nyando. Indeed, there is no difference in maize yields from 4 years of sequential improved fallows and from a control maize crop, and projections show a declining trend, implying that coppicing fallows are a better option (Girma et al). But Gacheru and Noordin aver that maize inter-planted with mixed fallows performs better than maize alone. However, it is not easy to show the effect of improved fallows on yields because of other factors leading to controversies around improved fallows. Also, the effect of fallows on striga was difficult to capture because of poor establishment as a result erratic rainfall, browsing of the fallows by livestock, and pests and diseases.

We therefore need a multidisciplinary approach to address issues such as how to assess impacts and yield, who does this assessment, identify the best way forward with improved fallows, and what baskets of options/technologies can be offered to farmers for different objectives. The analysis/synthesis should also include a candid and objective self-appraisal on the basis of scientific measures of the costs (labor included) and benefits of improved fallows. Agroforestry may not be or is not a panacea for all places and more knowledge is needed on different farming systems. To help inform this debate more, work by Walsh, Hailu and Verchot on effects of tree legume fallows on maize yields in Eastern and Southern Africa should be appropriately documented.

The ARIDSAK project success in Eastern Kenya is due to an integrated, collaborative, multi-disciplinary, participatory, and inclusive approach, and incorporation of training and field visits (farmer-to-farmer challenges). Drawbacks include wildlife and roaming livestock, unfavorable climate conditions, inadequate staff, resource poverty of farmers and socio-cultural factors. The field visit to Kibwezi was a revelation to ICRAF staff working in western Kenya, and it exposed them to different ways of doing things (presenting baskets of options/processes to farmers, flexible and adaptive implementation approaches and good researcher-farmer linkages. A key lesson was the breakthrough transformation of the formerly pastoral Maasai to adopt live fences, fodder trees, seeds, and vegetables production. This approach is useful and can be applied to lead Nyando farmers away from unprofitable maize to activities that are more productive.

Participants found the meeting very constructive as a first forum for critical assessment of improved fallows, with open discussion of pertinent questions and issues, including negative aspects. We need an integrated approach because currently we are only dealing with one aspect (improved fallows) YET farmers are multi-objective. As researchers, we can borrow a leaf from the farmers and think more broadly, work as a team, and investigate and remove the research - extension disconnects. This should lead to design and delivery of appropriate basket(s) of options to farmers, covering various aspects such as soil fertility, fodder, firewood and erosion control.

Before the TransVic Project Second Phase, we need to discern /determine: 1) what works; 2) where it works; 3) what can or should be done; and 4) especially; do we need more research? Transvic project could be more effective in Nyando if the project incorporates farmer perspectives and integrated production approaches, as is the case with ARIDSAK project.
Key recommendations from the meeting include:

- Use a more integrated approach to solving land management problems: a basket of options rather than depend on improved fallows only

- Synthesize work done and findings so far on improved fallows for a more balanced account of the technology.

- It is important to try other agroforestry systems such as rotational woodlots, fodder banks, live fences, and other high-value trees besides mango, as well as the role of trees in wastewater management. Therefore, what is required is a basket of options or processes for farmers.

- Focus on non-agricultural lands as well because they account for substantial erosion and 60% of total land use.

- Expose more Nyando farmers to Kibwezi as the best way to diffuse extension messages.

- ARIDSAK, KEFRI and KARI should be involved in future work on designing options for Nyando.
1. Background

In July 1999 ICRAF and the Kenyan Ministry of Agriculture and Rural Development initiated a collaborative project on 'improved land management in the Lake Victoria Basin' commonly known as the Transvic Project with finance from the Swedish International Development Agency (SIDA). The purpose of the Project is to provide extension providers, policy makers and researchers with information, methods, technologies and approaches for improving land productivity while enhancing local and regional environments.

The overall objectives are:

a) Identify and evaluate land management 'hot spots' in the Lake Victoria Basin and identify intervention points for preventing or mitigating those hot spots.

b) Identify and evaluate technologies, institutional arrangements, and policies for alleviating poverty while protecting the local and regional environment of the Lake Victoria Basin.

c) Quantify the actual and potential impacts of promising land management interventions on human welfare (food security, income, gender equality) and the environment (soil quality, water quality and hydrologic function).

d) Enhance research and extension linkages for improved land management in the Lake Victoria Basin (funded from A&A funds of NALGP).

2. Improved Fallows in Nyando: Why the Field Visit to Kibwezi and Meeting at ICRAF?

Since the project's inception in 1999, our approaches to improved fallows and N-fixing herbaceous and fodder species in the Nyando Basin have been disappointing. Experience from Maseno and Vihiga is not directly transferable to Nyando initiatives because the two areas have different agroecological conditions. Vihiga has better well-drained soils and higher, well distributed rainfall while the Nyando basin is mostly characterized by poor soils that are alternately subjected to massive flooding in the rainy season and deep cracking in the dry season exposing crop roots. Short-term fallows might therefore be inadequate to rehabilitate the severely degraded soils in Nyando.

Participatory rapid appraisals (PRAs) conducted since the start-up phase have clearly indicated water as the number one need across almost all focal areas in the TransVic Project. This is certainly true for the Nyando Basin, where water is a liability in the rainy season and a limitation in the dry season owing to its scarcity.

Against this background, a small group of TransVic project staff and RELMA colleagues visited the Agricultural Development in Arid and Semi-arid Kenya (ARIDSAK) Project in the drylands of Eastern Kenya on 24th and 25th March to draw lessons from their dryland experience in development initiatives and water management (water harvesting and prospecting, dam rehabilitation, tree planting, and community mobilization).

A half-day consultative project meeting at ICRAF Nairobi on 26th March 2003 followed the field visit. The aims of this meeting were to:

a) Reassess work on improved fallows and the broader context as we approach the final year of Phase I of the project. Specifically review lessons on improved fallows in western & eastern Kenya;
b) Synthesize lessons from the ARIDSAK Project for designing options; and
c) Map out recommendations.

Specifically, the objectives of the 1/2 day meeting were a) report status of improved fallows (trials) in Nyando; b) learn from ARIDSAK experience in Kibwezi and c) make recommendations for the future.

Chair: Chin Ong Logistics: Neccah Majisu & Antonio. Okono
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3. Presentations and Discussions

A. Effects of tree legume fallows on maize yields in Eastern and Southern Africa - Girma, H., Walsh, M and Verchot, L., ICRAF

The study objective was to compare improved fallows versus farmers practice, and specifically:
1) compare effects of sequential and simultaneous fallows versus natural fallow or continuous maize, and
2) compare single and multiple year fallows versus farmers practice.

A total of 32 trials located in 15 sites over 11 years were reviewed. The trials were located as follows: 11 in Zambia; 5 in Tanzania; 6 in Malawi and 6 in Kenya. The Meta analysis used fallow type, fallow duration, fallow species, biomass yield, maize yield and rainfall.

The average rainfalls and patterns were unimodal in Tanzania - 800 mm, Zambia - 1000 mm and Malawi - 1024mm, and bimodal in western Kenya - 1600 mm.

Fallows are normally differentiated by whether they are short-term, sequential, simultaneous or long-term (2-3 years). In this study, the improved fallow species that were evaluated were:

i) Sequential - Sesbania sesban, Sesbania macarantha, Tephrosia vogelii, Lablab purpureus, Crotalaria grahamiana, Desmodium sp, Clitoria ternatea, Cajanus cajan, Archer dolichos and Macroptilium atropurpureum.

ii) Simultaneous (also referred to as coppicing) - Acacia angustisima, Leucaena leucocephala, Gliricidium septum, Senna spectabilis, and Grevilea robusta.

Data analysis

Data analysis was challenging mainly because of the many sources and species, and the different agroecological conditions. Screening was done for multiple years, implying exclusion of single-year tithonia fallows, and the remaining 10 sites were ranked using a lagged yield scale. Inter- and intra-site variation was explained by site and time of data collection (seasons). The control was a continuous maize crop.

Results

• Fallow duration had a negative effect.

• Maize yield projections show a declining trend, implying coppicing fallows are a better option. In the US, commercial maize production registers 6.5 tons yr\(^{-1}\), and thus the question is "how long will it take to achieve these yields using improved fallows?"
Data from randomized block design experiments show declines, and after 4 years of sequential improved fallows, the maize yields are the same as the control maize crop. Declining effect implies that there is no difference between sequential improved fallow systems and continuous maize crop.

Plenary Discussions

- Erosion is not an issue in the study sites. However, in Vietnam, the greatest benefit of improved fallows is erosion control.

- The experiments, data management, and analysis are extremely expensive in terms of money and time, and therefore we need better ways based on minimal data standards (organic matter inputs, erosion and fertility) to assess impacts of improved fallows.

- Results from Siaya/Vihiga Pilot project show that *Crotalaria grahamiana* improved fallows lead to run-off control and aggregate stability.

- Maize yield decline is a function of biomass decline. It is not easy to show the effect of improved fallows because other factors, e.g., pests and recycling of nutrients come into play. The worst-case scenario may be that improved fallows are promoting nutrient mining through biomass take-off. In Zambia, however, despite declines, sequential fallows lead to higher yields than continuous maize. Declining rates of returns have been observed especially if factors are fixed, and we need a better understanding this through a multi-disciplinary approach. Declines may also emanate from a good maize crop shading out the improved fallows, or some improved fallows sharing pests with maize, exacerbating the problem further.

- Key questions. How do we capture farmers’ perceptions, crop rotations, time lags and modifications (e.g., mixing fallow species)? In Siaya/Vihiga farmers are convinced that improved fallows are effective, what will work in the Nyando Basin or similar places? Do we broaden fallows to cover all soils, from the best to the degraded? Improved fallows cannot succeed in heavily degraded soils, and soil fertility is governed by water availability, thus there is need for initial or baseline soil evaluations.

What is required is a basket of options or processes for farmers.

The presentation and discussions point to controversies that surround improved fallows, and bring to the fore the need for a multidisciplinary approach, and the biggest questions are - how do we assess impacts/yield factors, and who does the assessment - researchers or farmers?

B. Runoff and erosion from various land uses and management options in lower Nyando - Mwangi Hai, ICRAF/M OARD

The eutrophication problems of Lake Victoria have been strongly linked to soil erosion, and this is associated with land use related problems such as clearing of surface cover. It is hypothesized that "conversion of land to less stable conditions in steep slopes could lead to increased degradation and costs of effective management".

A baseline assessment of runoff and erosion was made on five land uses - cultivated, footpaths, grazing, bushland and severely degraded in 2000 in Nyamarimba, Ragen and Bur-Kamach. In this study, a paired watershed approach was applied with runoff measurements at plot and
catchment scales. In the baseline assessment, land use types and the respective directional changes over the period 1961 - 2000 were cultivated (+ 67%), grazing (- 39%), roads/footpaths (+ 200%), bush cover (- 7%), and severely degraded lands (+ 10%). It is therefore concluded that cultivation enhances episodic runoff and erosion; while degraded land and footpaths had the highest runoff; and bushland provide the most effective protection to soils.

The study is continuing and the objectives of continuing study are to 1) evaluate effect of isolating grazing and degraded areas on runoff and erosion, and 2) evaluate performance of *Tephrosia Candida* as a short fallow and its effectiveness in reducing runoff and erosion.

**Methods**

Two degraded and two normal grazing plots were isolated from livestock for one year from April 2001 at Nyamarimba and Bur-Kamach. Another two were left open for grazing. An annual fallow with *Tephrosia Candida* was relay-planted on four plots in each area with a maize crop in April 2001. Maize was harvested in July and the fallow in February 2002. For both interventions, runoff was monitored throughout the year.

**Results**

**Grazing fields**

There was no difference between grass yield from isolated and open grazing fields at Bur-Kamach, while isolation more than doubled grass yield at Nyamarimba. However, in order of magnitude, the plots at Bur-Kamach produced more grass than Nyamarimba.

**Degraded fields**

Fencing more than doubled grass yield at Bur-Kamach but had little effect at Nyamarimba. The best recorded grass yield from an isolated degraded plot was 17 times less compared to grazing field. Intra-plot degradation differences seem to have more influence on grass yield meaning that isolation is more effective for less degraded areas.

**Fallow**

The difference between biomass yields at Bur-Kamach and Nyamarimba could not be explained by nematode infestation or rainfall. More work is on going to determine die actual cause. The fallow is produced at very low opportunity cost as the second season is often left fallow. The market value of stem biomass is US$ 16 (Bur-Kamach) and US$ 90 (Nyamarimba) per hectare.

**Reduction in runoff**

Provisional results suggest that the fallow at Bur-Kamach had insignificant impact on runoff and erosion, while the fallow at Nyamarimba resulted in runoff reduction of 10-15%. The isolation of degraded plots across the two areas showed no difference in runoff reduction, and there was no difference between isolated and open grazing fields at Bur-Kamach. But, compared to 2000, surface runoff fell by 30% in 2001 at Bur-Kamach due to a denser grass cover.

**Conclusions**

- The grass and short fallow yields suggest that falls’ effectiveness and recovery of grass cover are strongly influenced by prevailing degradation levels.
• As degradation increases, fencing alone is inadequate and other technologies would be
needed, while short-duration fallows may not be useful.

• Isolation of grazing area could reduce runoff and enhance possibility for higher livestock
output through more intense production systems. Good grass performance could be important
in developing intensive cut-and-carry dairy systems.

• Short-term fallows reduce runoff and provide needed fuel, and could be an important
technology on critically energy-deficient areas in the plains.

**Plenary Discussions**

• Production can only be measured over short periods; therefore what was used was
standing crop and production - an issue of definition, which needs clarification. For example,
how do we measure yield, productivity and standing mass?

• Whereas it was averred that "fallows will not rehabilitate degraded lands", this is not
supported by the data. It is too general and consumption was not taken into consideration.
However, there may be other ways such as re-establishment via germplasm reintroduction.

• Annual wood yield depend on 1) degradation, and 2) deposition, which leads to better
yields.

• Terrain effects were taken into consideration by having plots on the same gradient, and
major factors are land cover and soil types.

• This work can be supplemented by PhD studies currently under the supervision of
Paramu Magongoya on short-duration fallows and water storage/runoff in Zambia, which
showed reduced run-off and increased firewood availability.

• A number of questions arise. How do we fit improved fallows to cropping seasons vis-a-
vis the study objectives and soil properties? It is important to consider crop sequencing and
improved fallows, continuous grazing and social factors. Coppicing fallows may fit better;
otherwise we may be trying to fit a square peg on a round hole. We should not force
improved fallows on what they cannot do. We are not an "International Institute of Improved
Fallow". What is required is systems thinking.

*This meeting was very useful. It is the first forum on improved fallows where pertinent questions
and criticisms have been raised openly and constructively. For example, after how long do
yields improve or decline; and what are the economic benefits? Still in the balance are issues of
erosion, run-off and firewood. We need an integrated approach because currently we are only
dealing with one aspect YET farmers are multi-objective.*

C. **Improved fallow for soil fertility improvement and Striga Management** - Eva Gacheru
and Qureish Noordin, KARI and ICRAF

Severe land degradation has been identified in the Nyando river basin. Striga infestation is
associated with low soil fertility. PRA reports cite low soil fertility and Striga as limitations to
food security. Results from research in Maseno indicated that improved fallows can increase
yield and reduces Striga and on this basis, improved fallows trials were started in the Nyando
basin. Options for soil fertility and Striga management using improved fallows included both
short-duration and coppicing species. Some of the activities undertaken were: species screening
and management; biomass assessment and crop response; and, effect of improved fallows on Striga infestation.

**Data and results**

The improved fallows were in the field for between 6 and 8 months and preliminary analyses show that:

- *Tephrosia Candida* does perform well in Katuk Odeyo.
- Mixed fallows perform better than single strands.
- Improved fallows lead to higher yields than maize alone.
- In Nyando, nitrogen is more important and phosphorus is not an issue.
- Striga control was captured through Striga counts. Only in one site was it found that *Sesbania* significantly controlled Striga. However, it had been mixed with *Desmodium* making attribution difficult.

**Limitations/challenges**

Data was limited to single year, and there was livestock interference especially goats which fed on the improved fallows because of free grazing-access rights.

- Fallow establishment is poor because of erratic rainfall.
- Limited information on improved fallow species for marginal areas.
- Effect of improved fallows is not immediate.
- Pests and diseases.

**Plenary Discussions**

- Pests attack improved fallows, which implies that they are not a complete package. Currently we have too few species and only one provenance.
- Though Striga counts were done pre- and post-crop (1 year season), the improved fallows were however not pure as they were planted with maize.
- It is very important to clearly distinguish between the "benefits" of improved fallows with respect to Striga control and nitrogen fixation.
- The main problems are soil fertility and Striga, which call for the integration of legumes, but how?
- If improved fallows do not work, let us acknowledge this and seek other options (e.g., animal manure or composting). Animals were and are at the core of development in central Kenya, and research into this is crucial.

*We need to think broadly, work as a team, and investigate and remove the research-extension disconnects. This should lead to delivery of basket(s) of options to farmers. Before the TransVic Project Second Phase, we need to discern/determine: 1) what works; 2) where it works; 3), what can or should be done; and, especially; 4) do we need more research?*
D. Agroforestry for Integrated Development in the Semi-Arid Areas of Kenya (ARIDSAK) Project - Linus Wekesa, ARIDSAK.

This Project was conceived by ICRAF and KEFRI in 1990s. **Motivation for the Project** emanates from very high poverty due to low land productivity as a result of declining soil fertility; over exploitation of available resources; lack of bio-diversity of valuable trees, shrubs, herds, crops and grasses; and lack of appropriate technology and information in safe guarding crops yield and animal losses due to disease/pest incidences.

The **Project** goal is to improve household livelihood through integrated productivity approaches, while the **objectives** are:

- To develop, test, implement and promote appropriate agricultural and agroforestry technologies with potential to improve farmer economic status,
- To strengthen research-extension-farmer linkages, and
- To develop supportive policies for the adoption of new technologies in the arid and semi-arid lands (ASALs).

**Time of operation:** Pilot phase from September 1997 to September 2000; Prolongation of pilot phase September 2000 to September 2002; and Main Phase (proposed) for September 2002 to 2005. **Area of coverage:** Pilot phase in Makueni, Kajiado, Machakos, Kitui, Mwingi and Taita Taveta Districts.

**Project Implementation Process**

**Objective 1: Research and Development**

**Activities**

I. **Establishment of high-value Trees as experimental trials**

Survival counts and initial growth being assessed

II. **Monitoring of the on-going Agroforestry tree trials**

Most of the collected data being evaluated with time and reports compiled.

III. **Establish crop trials**

The new crop varieties/cultivars under investigation indicate high yields compared to the local unimproved crops.

IV. **Establish pasture trials**

Some grass species are yielding over 15 tons ha\(^{-1}\), i.e., 3 times more than open pasturelands.

V. **Water and soil moisture trials**

This activity is being implemented on cost-sharing arrangement on-farm and with schools and nurseries, and beneficiaries are slowly implementing their part of the deal.
VI. Agroforestry with schools
   Water availability and protection determining total seedlings planted.

VII. Nursery trials
   Currently scaling down on-station seedling production for distribution hence only research-related seedlings target has been achieved.

   On-farm seedling production is restricted to highly commercial species.

Objective 2: Processing and marketing of Agroforestry products

   Support communities in processing and marketing Agroforestry products

   Support to the processing and marketing groups is on cost-sharing basis and groups are still making part of their contributions. This activity was expected to be complete by September 2002.

Objective 3: Fields days

   Field days successful, and food utilization exhibition has been incorporated into this component. Each family was expected to attend but the response was a disappointment.

Objective 4: Capacity Building

   Carry out training of farming communities

   Training is on-going and covers research-development related project activities.

Objective 5: Student research

   University students undertake fundamental research for the project as part of their academic output.

Objective 6: Policy Documentation - Land policy inventory.

   The contents of the report and its articulation of issues were not satisfactory/convincing as per the terms of reference specification thus returned back to the consultant for further improvement.

Objective 7: ARIDSAK Project's Future

   Preparation of next phase identification document

   Identification document is under consideration by the Governments of Kenya and Belgium.

Objective 8: Collaborative activities with Integrated Natural Resource Management (INRM) Project

   Execute collaborative activities with INRMU Project

   The project is currently collaborating with INRMU project in execution of joint research and development activities that were agreed upon in 2001.

Objective 9: Dissemination of Project results

   Presentation of project results/findings in workshops
Apart from the newsletters produced, the project also targets workshops and meetings as venues to dissemination of its findings for wider audience.

**Objective 10: Impact assessment**

*Conduct impact assessment of the project*

Impact assessment was expected to end by August 2002.

**Objective 11: Reporting**

*Technical reports and dissemination of results*

Have been distributed to all ASAL districts, local universities, Government Ministries, research institutes, farmers and interested individuals.

**Factors that Positively Contributed to Results**

The exemplary high level of achievement made by the project in the area could be explained by the following:

- An integrated and collaborative approach.
- A multi-disciplinary team of qualified experts that was highly committed to creating an impact in the area.
- Participation of the beneficiaries in the implementation process.
- Inclusion of the earlier omitted activities of water and marketing.
- Adaptive research is undertaken on the technologies easily affordable to resource-poor farmers, and on the basis of total commitment arising from anticipated benefits from fruits and timber/poles tree species, and other high yielding crops.
- Training and field visits including farmers exchange training that created a lot of enthusiasm with the beneficiaries.

**Factors that Negatively Affected the Realization by the Project**

- Problem of wildlife and roaming livestock.
- Unfavorable climate conditions exacerbating production risks.
- Unrealistic assumptions by the original project on water and marketing.
- Limited resource base of farmers that reduced the level of cost sharing or implementation of key technologies.
- Inadequate staff especially at the initial stages of the project.
- Socio-cultural factors especially with pastoral community in terms of cultivation, participation of different gender groups, etc.

**Lessons from the Project**

I. The integrated and collaborative approach. One of the reasons why the project succeeded well with farmers was the integrated and multi-disciplinary approach used. Such an
integrated and collaborative approach presents options in different disciplines to the farmers enabling them to make choice based on their interests, needs, preferences and constraints. Such varied choices of alternatives presented to the farmers create a lot of enthusiasm thus increasing their level of adoption of the technologies.

II. Participatory approach linking farmers, scientists and extensionists. Such level of participation creates goodwill and ownership of the project by all stakeholders increases chances of success.

III. Technologies under promotion should bear results within a short period of time to make their adoption high and are not too sophisticated to be applied by the common farmer.

IV. Agroforestry land use encompassing packages of different technologies can develop ASALs areas sustainably where production risks are high.

V. There is potential for economic forestry production in the ASALs for timber e.g Melia volkenseii and fruit trees like mangoes.

VI. The ASALs have vast potential for globally high-value fruits (local and external), e.g., mangoes, grapes, and oranges that can easily generate substantial income for poverty eradication.

VII. Farmer-to-farmer challenges raised standards of the application and management of technologies hence higher impact.

VIII. On-farm research made farmers easily identify better quality production technologies e.g. improved crop varieties controlled on-station compared to their practices.

IX. Provision of resources that are in demand and that impact positively on natural and international markets was done in addition to water accessing technology, thus giving a holistic package to farmers problems.

E. Field Visit to Kibwezi

Members who undertook the trip commented on the trips as exciting, an eye-opener, is realistic in approach, and quite a challenge.

Participants, however, noted the key lessons as:

- Pastoralists have adopted agroforestry and horticulture for increased income generation mainly after promotion of high value trees as better alternative to maize or pigeon peas.
- ARIDSAK strength lies in flexibility to improve implementation, and the good links with farmers. However, though research-extension linkages are important for scaling-up, not much was seen on the ground.
- Briefs and profiles of each farm/farmer.
- Good sites selection that took into consideration variations.
- Basket of options that are easily usable by farmers - pasture, fruits, water conservation, etc., all on the same farm.
- Grass species testing is very relevant for the Lake Victoria basin.
• Fodder species narrow because of climate.
• Keeping bees inside houses is very innovative as it increases honey outputs and is gender sensitive.
• Breakthrough - live fencing especially among the Masai for fodder trees, seed and vegetables production is innovative, and is lesson is applicable in the Trans Vic Project.
• Water harvesting, conservation and management especially as they affect crops, moisture and structural harnessing, and how to economically use Mt Kilimanjaro waters require more work on the economics.
• Need to shed more light on human-wildlife conflicts.
• A very time-oriented approach that incorporates manure in the short-term; pigeon peas in the medium-term, and trees in the long-term. Tree species can be transferred between regions, for example, Melia from ARIDSAK to Nyando basin and Zizyphus from Sahel to ARIDSAK (action - Steve Franzel).
• There is great ownership of work by farmers. Teamwork among staff and linkage to commerce/marketing are prominent. The drawback is the low prices offered for honey (Kshs 60/Kg in Maseno honey goes for Kshs 400/Kg).

F. General comments on field visit and meeting

• Improved fallows are/were not well conceptualized in extension raising the question of what do we do with improved fallows which goes back to a basket of options/technologies for different objectives - soil fertility, fodder, firewood, erosion control, etc.
• High value trees are an important lesson for the Nyando basin from Kibwezi. Others are dryland crops/grasses, which have been researched by KARI for transfer to Nyando. However, more work is needed.
• Off-season grazing or the grazing culture in general, and access and property rights are pertinent to understand in the Nyando basin.
• Though leguminous improved fallows improve soils they are not a panacea nor a miracle; consider diversity and rotations because pests thrive under continuous and stable conditions; therefore fallows should not last for more than 9 months. Biomass is the core issue because of fixed amounts of nitrogen. Agroforestry is not a panacea for all places and more knowledge is needed on systems. However, improved fallows have a big role in lower Nyando where maize stalk is used as firewood rather than for nutrient recycling. Melia is a good substitute for Eucalyptus, and therefore in the TransVic Second Phase get critical numbers of Melia to farmers.
• An extension manual "Improved fallows for Western Kenya: An Extension Guideline" has just been launched. However, we should ask, will improved fallows stand the test of time? There also similar sentiments like those expressed in this workshop but by different people and quarters.
• Increasingly farming in western Kenya is being left to the elderly (mostly widows). How do we incorporate all ages, the rural youth, and resource poor? NALEP has currently no deliberate approach to target the youth.

• Participatory farmers' involvement leads to better impact, e.g., Katuk-Odeyo can forego a crop, fence of land and can have grass to sale in a few months.

• Get better germplasm/provenances that have better survival and growth rates and better link farmers to big firewood consumers - Homaline, Tea factories, Sugar factories, etc, that broaden species availability.

• Waste water purification using agroforestry (VI - Agroforestry) especially bamboos is an important niche - New Zealand hybrids.

• TransVic has a budget for formal links with ARIDSAK.

• Walsh, Hailu and Verchot should document their work for proper understanding of their research and for basis of their conclusions to be put in proper perspective. Work in Machakos is not different from the improved fallows but it enjoyed more and better data. Incorporate RELMA experiences. Assessment of improved fallows in the Nyando basin may however, be premature as it only covers 3 years. Also draw lessons from VI-Agroforestry work in West Pokot especially fodder trees and woodlots and maybe visit Tanzania to look at woodlot for timber and charcoal. In Tanzania, indigenous trees such as Acacia and Melia are being used for charcoal - a big problem.

• It is now time to struggle with context and a great opportunity to rehabilitate unproductive lands through leguminous trees and grasses, address concerns with high population increases (2.8%) and soil loss into Lake Victoria. These lead to the bigger issues of range management, forests, peoples' ways of life, culture, socioeconomics, food security - own production and market access. RELMA has done work on animal husbandry and marketing.

• Successful turning of farmers away from maize by ARIDSAK is a lesson worthy borrowing by the TransVic Project. Next visit take Nyando farmers to Kibwezi. On the issue of options, consider tree crops, pasture, amplification of VI work, and get away with institutional fixation with improved fallows and cereal production. This entails radical alteration of agricultural production in western Kenya. However, a number questions remain begging: What are economics of maize production in Nyando still begs? What are problems associated with maize production? What is the role of maize in the society? How do we link use of improved fallows to the markets? How do we address the issue of inputs and risk and internalize it in extension? All said and done, farmers are smarter and know where and when to make a cent, and researchers do not live the risk. They can shift base. And movement away from maize is or can only be gradual. Let farmers impose challenges on each other through exchange visits.

• Maize is a new crop in Nyando; hitherto, mere were other enterprises - cotton, coffee, sugarcane, etc. Maize is not cultural; it is a manifestation of lack of alternatives. Therefore aim for the big picture through use of knowledge/information, consideration of other factors like culture/religion (non-eating of cowpeas), etc.
G. Three Key Issues or Lessons to Take Home by Each Participant

- The importance of short, medium and long-term strategy with an integrated approach addressed by diversified knowledge capital is a key for economic, social and environmental benefits.

- The need to plan together as a team for soil fertility options in Nyando Basin not Nyando District.

- The need to integrate as many options as possible in the package made available to farmers, which should include crops, trees, animals, environment and farm management options are market-based and take into consideration environmental sustainability and their effects on peoples’ livelihoods.

- There is need to put together data and issues on improved fallow - the science as well as the social aspects, synthesis work.

- A thorough integration of productivity enhancement, and soil and water management is urgently needed to turn the tide of environmental degradation.

- Suggest a candid objective self - appraisal based on scientific measures of the costs (labour included) and benefits of improved fallows. Farmers stories are very good (put a human face) but:
  - They only present the experience of one farm/person
  - They are anecdotal
  - They cannot withstand scientific rigour
  - They may not be representative of the wider community

- Transvic project could do wonderfully well in Nyando if the project incorporates in other aspects within the farmers perspectives that will involve integrated production approaches as the case of AREDSAK project. In undertaking all these different enterprises/activities, the farmers will be able to adopt the improved fallows as an option of improving that land productively. It is important that all such aspects are considered because of the elements of energy and complementarily that are nurtured to enhance technology adoption. Need to bear in mind that farmers operate from a complex production function that needs to be well perceived and improved through integrated approaches.

- Designing options for farmers in Nyando: Approach should be integrated in terms of technology (i.e. various agroforestry options on the farm) and multidisciplinary - with focus on short-term to market/income generation opportunities. Socio-cultural factors are very important.

- Have many training workshops for subsistence farmers, and assist them financially
There is need for greater experience sharing avenues, and the collaboration between ARIDSAK and Nyando (TransVic) programme should be strengthened.

These is great need for Trans Vic to emphasize greatly on farmer experiences as entry points for these interventions, a strong ingredient for sustainability and technology ownership.

As we diversify, it is important to focus on efficiency in production so that the prices remain competitive (surpluses, markets and marketing).

We need to introduce a basket of options to farmers so that they can choose what fits into their conditions e.g. short-term, medium-term or long-term.

Great forum for discussing (ICRAF) institutional options for land management productivity

H. Some Recommendations for the Future

- Use a more integrated approach to solving land management problems: a basket of options rather than depend on improved fallows only.
- Synthesis of improved fallows is essential for a more balanced account of the technology: low rainfall appears to be a limit for the technology.
- Try other agroforestry systems such as rotational woodlots, fodder banks, live fences, and other high value trees besides mango.
- Focus on non-agricultural lands as well because they account for most erosion & 60% of total land use.
- Expose more Nyando farmers to Kibwezi; best to promote farmer-to-farmer extension.
- Use of trees for use of wastewater e.g. bamboo and poplar
- ARIDSAK, KEFRI & KARI to be involved in future work on designing options for Nyando.
Participants List

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