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Report on Approaches and Experiences of Knowledge Transfer of Technology

Authors: MetaMeta

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SEVENTH FRAMEWORK PROGRAMME

WP6: Adoption, knowledge transfer and dissemination to rainfed Africa

Report on approaches and experiences of knowledge transfer of technology

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Acronyms used

ATVET: Agriculture Technical and Vocational Education and Training

DA: Development Agent

FFS: Farmer Field Schools

WWT: Woreda Watershed Team

KWT: Kebele Watershed Team

MoARD: Ministry of Agriculture and Rural Development

MoWE: Ministry of Water, Mines and Energy

NRM: Natural Resource Management

NGO: Non Governmental Organization

PADETES: Participatory Demonstration and Training Extension System

PAF: Project Agro Forestier

PRA: Participatory Rural Appraisal

1. Introduction

This report is written as part of the Water Harvesting for Rainfed Africa: in investing in dryland agriculture for growth and resilience (WAHARA) project that is financed by the Seventh Framework Programme (FP7) of the European Commission. As part of work package 6 entitled 'Adoption, knowledge transfer and dissemination to rainfed Africa' this report constitutes internal deliverable (I5), which aims to capture the local (study site specific) as well as national approaches and experiences in knowledge transfer of water harvesting (WH) technologies. This report serves to support both the identification of prospects for scaling-up WH technologies (Del.6.1) as well as more specifically for developing multi-level strategies for scaling-up WH technologies by joined learning and action (Del.6.2).

More specifically this reports aims at describing the exact method of knowledge transfer and actors involved in the study site countries. Getting to know the mechanisms of whom learns from whom and what is exactly taught or learned at different levels of society is important to be able to identify any viable option for up-scaling of any technology. If farmers and communities for example learn more through farmer field schools (FFS) than through regular government extension services and training, or that farmers learn a lot from a dedicated government NRM (Natural Resource Management) extension officer or regional NGO (read the cases in Tigray and Hararghe, Ethiopia below), these mechanisms should be known and incorporated into any up-scaling strategy.

To compile these reports for the different study sites and countries the following working method was used:

- Study of secondary data, country reports and in particular all WH related documentation, including the 'historical and success-stories analysis' (WP1, Task 4)
- Interviews and study of video-documentation of key informants (including the study site coordinators)
- Analyse actor – stakeholder interactions, with regards to knowledge transfer
- Enumerate (multi-level) knowledge transfer mechanisms

Included in this report as inventory are the four following chapters each describing the different countries that are part of WAHARA and this study into knowledge transfer mechanisms. The chapters are structured highlighting: specific governance structure, strategies and guidelines and a description of how policies and guidelines are being put into practice.

Underneath in a short paragraph, the concept of initiatives, best practices and their related criteria are reflected upon. This paragraphs aims for the reader to be able to distinguish the concepts and understand the contextuality of knowledge transfer mechanisms.

1.1 Initiatives, Best Practices and Criteria

An *initiative* is phrased as: exploring ways (approaches and techniques) to: improve a given situation or respond to a certain problem. Given the scope of WAHARA these initiatives relate to soil and water conservation; soil fertility and water management and landscape improvement at (sub-)catchment scale. These initiatives are commonly undertaken by: farmer innovators, development or government agencies and research institutes. The success of an initiative is then measured by:

1. the degree of farmer involvement in refining the techniques;

2. the level of local adoption; and

3. the effectiveness of the approach or techniques, whereby the land users themselves (contextual) determine the success on the basis of their own criteria

The latter measure of success is however more applicable in rainfed farming than in irrigation and/or scheme farming, because in schemes a common pool resource, i.e. surface or ground water is used, whereby rather than individual criteria, common (scheme) criteria determine whether an approach or technique is successful.

Besides the word initiatives, *good and/ or best practices*, are also often referred to when it comes to epitomizing (new) approaches and techniques in soil and water conservation. It is however good to consider what exactly such a designation entails, as well as how this relates to previously described initiatives and the criteria to determine their success.
A given practice, i.e. a farming approach or implemented technique, would only be considered good when it has had exposure to the criteria of individual farmers as well as farmers that are dependent on a larger scheme (for either water and/ or nutrients). Perhaps the practice would be considered better, or best when it has also proven successful in a variety of geo-physical contexts and/ or when the practice also bears beneficial consequences outside the realm of farming (i.e. environmental benefits, socio-economical benefits, etc.). A 'best practice' is phrased by the oxford dictionary to be a set of 'procedures that are accepted or prescribed as being correct or most effective.' However in agriculture and with respect to soil and water conservation practise, it is the realm of land users and their criteria that makes it difficult to determine any most correct or most effective common procedure.

With regards to the criteria that farmers would use to measure success commonly these would relate to soil texture, composition and fertility, water availability and a farm's micro-climate, these of course vary per farmer. The criteria for measuring success would also vary and depend on the tools available to a farmer, i.e. for land tenure, tillage, etc.. Hence, although 'best practices' can certainly be identified, it is particularly the adoption of an approach and techniques by a farmer to suit his criteria which will determine success.

2. Knowledge transfer in Ethiopia

2.1 Policy in to action in Ethiopia

In describing the government – WH implementation practices it important to consider the structure of the Ethiopian government and possible paths that decisions are made and knowledge is transferred.

Ethiopia is a federal country that consists of four tier of government: federal, regional, zonal and wereda. Following the 'constitutional' legal framework, the country constituted nine regional states: Afar, Amhara, Benishangul-Gumuz, Gambella, Harari, Oromia, Somali, Southern Nations Nationalities and Peoples (SNNPR) and Tigray, and two special city administration councils: Addis Ababa and Dire Dawa. Regional governments were established based on ethnicity and language. The regional states are sub-divided into sixty six zones that are further sub-divided into seven hundred seventy six Wereda's. A Wereda, on average roughly consisting of 100,000 people, and under one Wereda there are many Kebeles that are the lowest administrative unit.

At the federal level the Ministry of Water and Energy (MoWE), the Ministry of Agriculture and Rural Development (MoARD) and is responsible for preparing national water and agricultural policy, strategy and action plans, and for establishing national standards for, amongst other things, water quality and infrastructure. The ministries are also accountable for overseeing the implementation of policy and strategy. In addition to this regulatory role, the ministries give technical advice (in the form of manuals and guidelines) to regional water bureaus. Large project or capital investments are however managed by the MoWE, in particular those relating to irrigation or hydro-power development.

At the regional level the Bureau of Water Resources Development is responsible for the implementation of federal agricultural and water resources policies by adapting them to the specific conditions of the region. Regional bureaus are also charged with providing technical support to Wereda's as they build their capacity in both urban and rural water resources management, agricultural development and catchment management. As such, regional bureaus primarily provide technical and financial (for capital investment) support for water resources management, landuse change plans and catchment management projects where required. The bureaus also have a regulatory role for certain tasks as delegated to them by the respective ministries.

Regarding water Zonal Water Resources and Agriculture and Rural Development Offices give technical support both to the Wereda water and agricultural bureaus in water resource management, agriculture and farming practice as well as catchment and water resources protection. Zonal offices are accountable for coordinating activities, plans and reports from Wereda's, and liaising between regional bureaus and Wereda bureaus.

At the Wereda level, Wereda Water Resources Development Bureaus are responsible for the planning, design and implementation of small-scale water resources development schemes (water supply and small scale irrigation).

The Agricultural and Rural Development office is responsible of all the extension activities carried out at Kebele level were up to three Development Agents (DAs) are based and offer service to the community through an array of extension mechanisms, of which Farmers Field Schools received a

boost in resources and attention in the past years. The agriculture ministries and the depending sub-offices are in charge of watershed planning, rainfed agriculture and of small water harvesting technologies. All watershed plans are compiled by DAs, aggregated by Weredas and approved by Zonal Agriculture and rural development office.

The above describes the 'responsibilities' of the different government levels that are involved in setting out policy into practice. Distinctly the different levels require a certain interpretation and transformation of knowledge. In Ethiopia, as chapter 2.2 shows, a large demand and urgency exists for water harvesting solutions in many areas. Knowledge is transferred not only through the government but also through NGOs and the upcoming private sector.

2.2 Government putting water harvesting put to practice

The Ethiopian Extension system: brief overview and challenges

Extension service was introduced in Ethiopia more than 50 years ago and despite its long lasting establishment it suffered from discontinuity of approaches. Extension changed radically with the political and societal changes occurred in Ethiopia. Alongside the move from Feudalism, to Marxism to a free market system also the extension services suffered major adjustments. At the moment extension is mainly provided by the public sector with the exception of few NGOs and private sector initiatives. For the most extension focuses on three main areas: crop production, Livestock production and natural resource management (NRM). The focus reflects the structures and availability of DAs at Kebele level (i.e. crop production, livestock production and NRM). It is within Natural resource management that the extension system is taking major steps in rehabilitating watersheds and introducing and scaling up Water Harvesting technologies. By learning from past experiences the government introduced the PADETES program (Participatory Demonstration and Training Extension System). PADETES is based on Farming Training Centers (FTC) coupled with a modified Train and Visit (T&V) approach. PADETES brought a massive increase of the number of farmers reached by extension. The system was reaching between 35 and 40% of farmers households in 2010 (out of 10 millions) in 2010[1]. The system has many positive points to learn from, but also several gaps that need to be addressed (see Table 1 below).

Achievements	**Weaknesses**
Reached many farmers	Majority of extension packages focused on agriculture
Increased productivity in many cases	Supply driven
Increased production of grains	Lack of regional and contextual strategies
Increased use of inputs	Narrow focus on cereals
Watershed rehabilitation scaling up	Incomplete use of packages by farmers
	Limitation in infrastructure, marketing and inputs
	Limited participation by women
	Limited training for extension workers

In the national extension system the NRM DAs play a vital role in the introduction of Soil and Water Conservation and Water Harvesting Technologies. The NRM DAs provide through T&V and FTC the

[1] Davis et al., 2010, In-Depth Assessment of the Public Agricultural Extension System of Ethiopia and Recommendations for Improvement, IFPRI working paper 01041

expertise necessary for the introduction of such technologies. Additionally NRM DAs and wereda focal experts are key figures in watershed planning as explained below.

To improve the Ethiopian Extension system some major recommendations are given by Davis et al (2010)[2]:

1. Extension must be farmer driven and flexible to accommodate local needs and priorities;
2. Broadening the spectrum of provided services and reached target groups. Special focus and different packages must address the needs of elders, women, pastoralist, farmers, and agro-pastoralists;
3. Augment the resources available for the FTC and promoting the initiation of revenue generating activities at Kebele level;
4. Strengthen the education of DAs at technical institute level (ATVET), but also with ad-hoc on the job trainings according to arising needs;
5. Strengthen DAs motivation;
6. Increase linkages throughout the system to work following a holistic system approach and by linking for example with research institutes and other governmental offices;

Through the **Community Based Participatory Watershed Development Guidelines** all local government offices in Ethiopia have a theoretical framework to follow when planning water and land management on a watershed scale. The watershed rehabilitation efforts entail the adoption of a vast variety of measures that includes many soil and water conservation technologies and rainwater harvesting measures.

Each community, Kebele and Wereda is bound to follow the guidelines and create plans for their area of interest. The steps outlined in the "Community Based Participatory Watershed Development guidelines"[3] are clear in defining the roles of the government in planning and implementing water harvesting technologies as part of watershed rehabilitation efforts:

1. Formation of a **Wereda Watershed Team** (WWT). This core team ideally is formed by ten members to cover the planning phase in a holistic way. The team must have the capacity to cover all matters related to: Soil conservation, forestry, Agriculture, Water Harvesting, Small Scale Irrigation, Livestock rearing, Land Use Administration, Food security, Cooperatives and inputs, Rural roads. The main tasks of the WWT are:
    a. Select and prioritize community watersheds;
    b. Identify interactions between adjacent watersheds;
    c. Organize, train and support DAs;
    d. Collect and review watershed plans. Prepare a wereda watershed plan by collating community watershed plans. Use the watershed plans to upgrade the wereda strategic plans;
    e. Specific technical trainings for farmers and for DAs;
    f. Assist in mobilizing resources for the implementation of the plans;
    g. Prepare proposals for linkages/synergies with other initiatives and organizations;

[2] Davis et al., 2010, In-Depth Assessment of the Public Agricultural Extension System of Ethiopia and Recommendations for Improvement, IFPRI working paper 01041

[3] Desta, L., Carucci, V., & Wendem-Agenehu, A. (2005). *Community based participatory watershed development: a guideline*. Ministry of Agriculture and Rural Development (MoARD).

h. Ensure timely monitoring and reporting using participatory approaches;
i. Ensure that an yearly review of the plans is done;
j. Proper documentation and dissemination within the wereda;
k. Integrate family planning with watershed planning;
l. Hold meeting every two weeks to review progress;

2. The Wereda Watershed Teams define the major watersheds in the Wereda. Subsequently, sub watersheds of maximum 6000 ha are defined. Among the selected watersheds the WWT prioritize and select critical sub-watersheds according to:
    a. Geographical position (upstream-downstream)
    b. Degradation levels
    c. Food insecurity
    d. Specific objectives (e.g. such as soil moisture deficit, poor access to markets)
    e. Resources and manpower availability;

    Once the critical sub-watersheds are identified the WWT delineates Community Watersheds that have a smaller area and are easier to manage. Each critical sub-watershed contains 1 (max 2-3) Kebeles.

3. Therefore a Kebele Watershed (KWT) team must be created. The Kebele role is to coordinate efforts between the different community watersheds present in one Kebele. In each KWT there must be:
    a. Kebele Chairman;
    b. Kebele Rural Development Head;
    c. Three DAs;
    d. One male representative of each community;
    e. One female member of each community;
    f. One youth representative of each community;

    The role of the KWT is to:

    g. Ensure watershed planning happens in each community;
    h. Set priorities;
    i. Coordinate interventions that concern more community watersheds;
    j. Resource allocation;
    k. Targeting and quality control;
    l. Settle disputes;
    m. Overall guidance;
    n. Regular meetings every two weeks;

4. The WWT defines Community Watersheds within the already identified critical sub-watersheds. The community watersheds must be smaller than 500 hectares for easy participation and avoidance of conflicts. For the same reason it is advised to have homogenous communities within one single community watershed.
5. The WWT meets the DAs at Kebele level and discuss the pre-defined community watersheds. Then the DAs will be trained on the principles and procedures of watershed

planning. In the end the tools needed for planning and surveying will be procured and/or organized.

6. The WWT and the DAs jointly visit the community and introduce the ideas of watershed planning. The boundaries of the community watersheds are discussed and refined while walking through the area.
7. The DAs facilitate the formation of a Community Watershed Team (CWT). The CWT must be agreed by the whole community in a plenary session and should represent all members of the community in its diversity (Gender, Age, Wealth, etc). The CWT role is to be the linkage between the community and the DAs for matters related to watershed planning. After the community has discussed thoroughly and agreed on all the aspects and steps of watershed development the planning phase starts.
8. A participatory survey of the community watershed is carried out. The main tools for this scope are transect walks and participatory maps. Both bio-physical and socio economic aspects need to be investigated and discussed.
9. Problem identification and problem analysis are carried out with PRA tools such as problem trees and the problem matrix. These help raise consciousness about community challenges and to reach a common point of view. Eventually the community can discuss a vision for change in which the future of the area is analyzed against the eventual future adoption of technologies such as water harvesting;
10. At the same time a socio-economic survey is necessary to reach a better understanding of the socio-economic layers of a community, its conflicts and needs;
11. The bio-physical planning starts with surveying the characteristics of the watershed such as borders, land cover and land use, streams, slope, soil type, erosion severity etc;
12. The DAs put together the information obtained with the socio-economic survey and the biophysical survey in a “base map”. With the map the DAs can start thinking of possible water harvesting measures that can help the community to overcome specific challenges in their livelihoods. The general assembly of the village is gathered to discuss these first findings with the aim of refining the identified problems and preliminary solutions. Before proceeding unanimous agreement needs to be reached;
13. From the surveys and community plenary discussions the CWT and the DAs select the possible technical measures for the treatment of the community watershed. The options are assembled in a draft of the “Watershed Development Plan”;
14. Once the plan has been drafted by the CWT and DAs it needs to be presented, discussed, refined and approved during a general assembly with the whole community; The CWT discusses every detail with the general assembly;
15. After discussion, all the points need to be assembled in the final plan that is composed by several documents:
    a. Development map: it sketches the existing assets of the community and adds the planned interventions. A copy of the map is prepared and kept by the community;
    b. Inputs estimation according to the planned measures (Materials, labour, Etc).
    c. An Action plan is prepared according to the discussion with the community. The action plan defines the role and the timing of the community involvement;
16. The plan is consequently reported using a standard format and it is delivered by the DAs to the wereda for checking and approval;

17. The wereda collects and collates all community watershed plans for approval at Zonal level, but also to check that the plans are not creating excessive externalities between each other;

Implementation

Once the plans are approved at Wereda and Zone level the implementation phase can start. The government offices have a prominent role in the whole process, but the ultimate choice and approval of any measures must come from the community. The Wereda, the Zone and the region are supporting the community with technical backup, process coaching and in case of need with supporting schemes for the weakest members of the community.

The community will participate in all implementing steps and beyond and working groups are created. The groups can be created by the CWT according to various mechanisms depending on the specific context. In certain cases for example traditional work groups already exist and are already a consolidated reality. Some other times it is suggested to create the groups from scratch.

The community is generally asked to contribute with labour and with locally available construction material. In some cases and especially in food insecure areas this option becomes not viable and the participation of the community needs to be supported by parallel programs such as safety nets.

It is of key importance that the community finds an agreement on the kind and size of contribution each household will put forward to implement the Community watershed plan. It is suggested that the community decides and come up by itself with a "contract" that defines contributions details according to the local by-law system.

Specific care must be adopted in promoting a fair contribution and role for the weakest households/individuals of the community. Special activities and the creation of Self Help groups are valuable tools to help the poorest in improving their situation.

Monitoring and evaluation

The communities are involved by the local governmental offices in monitoring and evaluating the watershed rehabilitation efforts.

Constrains regarding the Community Based Participatory Watershed Development Guidelines

The framework developed by the MoARD for participatory watershed management appears to be well structured and well thought. Nevertheless, good implementation is not always the case and it varies greatly from area to area and from program to program. Factors that lead to a successful implementation of the guidelines are often taken for granted while they are essential:

- Local and committed leaders can create the right environment for the implementation of watershed management activities. Ato Derebe (Box 1) is a bright example on how a committed person can favour radical changes in natural resource management;
- The connection between different realities and initiatives must be strengthened to put together resources but also the know-how that is already available locally. In Tigray the implementation of a pilot WAHARA project is proceeding well because financial resources were made available by local NGOs/churches while Mekelle university provided know-how and technical assistance;

- The turnover of DAs and technical woreda staff is a major problem that hinders the continuity of watershed rehabilitation efforts;
- Participatory on paper, the approach outlined in the guidelines is not always respected and in many cases farmers find themselves indirectly forced to work in public works schemes;
- Food for work schemes are often used to implement watershed programs, but they create a strong dependency on aid;
- Gathering baseline data coupled with good Monitoring and evaluation;
- Farmers innovators are present throughout the country, but their experiences and knowledge is not fully acknowledged;
- The most successful woredas are often the ones where the population have traditional knowledge on some forms of SWC and WH. Adaptation of the existing technologies leads to easier uptake and upscaling.
- Sometimes FTC are used for political indoctrination rather that farmer training (Personal observation);
- When the guidelines are fully followed and participation is taken seriously success is more likely to be achieved;

Informal extension systems – local knowledge sharing

A study in Northern Shewa and Southern Wello looked at farmer innovators identification and knowledge sharing dynamics[4]. The outcome shows how – to a certain degree - every farmer is a bit of an innovator and how community dynamics are used to share knowledge and local innovations:

- Rich innovator farmers with more land available tend to share their knowledge with the farmers tending their land. This way they make sure that their fields are attended properly;
- Innovator farmers with land in marginal and steep areas tend to experiment innovative SWC technologies. Other farmers learn from them mainly through direct observation and try to emulate them.
- When innovation is introduced by outsiders or by the government the community tend to prefer locally adapted technologies. For example the DAs tried to introduce graded Fanya juu terraces coupled with artificial waterways. The community immediately pointed out that the local solution (combination of traditional ditches and level bunds) was already available and that it was preferred. They showed to be proud of the local solution and more confident of its effectiveness.

Farmers to farmers extension is becoming a more common way of extension for Ethiopian communities. Nowadays, in some Woredas (e.g. Doba Woreda) farmers that are considered model farmers or farmer innovators travel from area to area occasionally to share their knowledge with other farmers that live in similar conditions[5]. Farmers are extremely proud to be seen as innovators and see it as a honour to be in touch with other realities where their knowledge is appreciated. Also in Tigray farmers travelling to seminars have become more common in the last years. The first experiments with this approach were carried out in 1998 and turned out to be successful. Consequently the regional government started to organize similar events such as farmers fora where

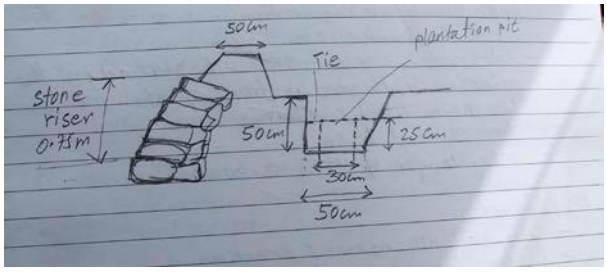
[4] Yohannes Gebremichael, 2001, Community assessment of local innovators in northern Ethiopia, In farmers innovation in Africa

[5] Personal information

farmers come together and share their experience on farming, SWC and water harvesting technologies[6].

Box 1: Decentralized knowledge

Capacity building comes from the government higher offices in many instances, but some shining cases of locally developed; highly contextual knowhow is sometimes present at Wereda and Kebele offices. Ato Deribe from Doba Wereda in West Hararghe is one of these individuals that adapted the government technical guidelines to the local context. In 15 years of experience with Water Harvesting he adapted the technical design of many technologies to fit the needs and capacity of the communities he works with. In Doba Wereda people have used stone terraces for generations. Ato Deribe is aware of this locally available resource and adapted the design of stone terraces, bunds, herring bones and eyebrows according to it. He modified and improved the government design and took notes of all the specifications in his notebook that he updates constantly with new ideas and details (see Figure below for an example). The new design of the technologies is well accepted by the community and it translates in a more efficient implementation with improved quality and more long-lasting structures.



2.3 NGOs putting water harvesting into practice

Non-governmental Organisations form a key component of the civil society in Ethiopia. Their presence in the country dates back to the mid-1970s, when (mostly foreign) NGOs took up the task of famine relief that appeared to be well beyond the federal government and rebel groups locked in civil war. Since the end of the conflict in early 1990s, their numbers have only grown. This has also led to a proliferation in the number of domestic NGOs [7].Together, the two have formed a 'non-government' sector that represents a substantial amount of financial resources, technical know-how and experience in implementing development programs. They are, therefore, natural stakeholders in any substantial intervention with regards to natural resource management.

As an example, the significance of the non-government sector is illustrated well by REST (Relief Society of Tigray) in Tigray province, where the WAHARA test site is located. Between 2006 and 2011, for example, REST had 8:

[6] Fetien Abay et al., 2001, Facilitating farmer-to-farmer communication about innovation in Tigray, From Farmer innovation in Africa
[7] Markakis, John (2011) *Ethiopia: The Last Two Frontiers,* New York: Boydell & Brewer Ltd.
[8] Relief Society of Tigray (2011) *Towards a Food-secure Future,* Mekelle.

- constructed 14 river diversions
- constructed 2150 hand dug wells
- constructed 223 shallow and 17 deep boreholes
- installed 32 irrigation pumps
- developed 250 springs

The example of REST is further described in 2.4.

Nevertheless NGOs nowadays are facing some financial challenges to get their activities under way and recognized by the government. In February 2009 the government issued the Proclamation to Provide for the Registration and Regulation of Charities and Societies (CSP). Consequently the government issued the "Ethiopian Charities and Societies Agency issued the Guideline on Determining the Administrative and Operational Costs of CSOs". This guideline contains some rules and caveats for CSOs and ties them to strict regime to follow for the declarations of their costs[9]. These new rule labelled informally the 70/30 rules can potentially hinder many activities of NGOs in Ethiopia. This rule limits the administrative costs of CSOs to 30% of their budgets. Under administrative costs also fall all the expenditures that an NGO will face when carrying out awareness building, baseline studies, trainings and monitoring and evaluation activities. Therefore, many organizations working on "software" rather than "hardware" are facing problems to carry out their activities as it used to be. Especially the organizations working on capacity building, awareness raising, trainings and human rights are finding this regulation too restrictive.

2.4 NGO-Government Relationship in Natural Resource Management and Knowledge Transfer in Ethiopia

The Government Perspective: That the government acknowledges the importance of the non-government sector is illustrated through the following excerpts from the national Community Based Watershed Development guidelines[10]:

"In several weredas, the presence of NGOs and other partners need to be considered for watershed planning as they often support or could support watershed-based interventions and could play an important role in supporting planning, implementation and M&E. .... This is also relevant for enriching watershed procedures and providing additional support for training and implementation at community level."

"... wereda experts will play a major role in strengthening the communication between the various sector agencies operating in the area by involving their experts and using their resources whenever required; for instance, education and health experts, NGOs and others."

The NGO Perspective: In the area of Natural Resource Management, big NGOs like REST view their comparative advantage to be:

(a) their close connections with the International Development and scientific communities
(b) their (self-proclaimed) closer ties with communities at the grassroot-level, and
(c) their flexibility (vis a vis the Government) in terms of identifying and pursuing emerging themes and technologies

[9] NGO Law Monitor: Ethiopia, (September 2013). Retrieved from http://www.icnl.org/research/monitor/ethiopia.html on 27th November 2013.
[10] Lakew Desta, Carucci, V., Asrat Wendem-Ageňehu and Yitayew Abebe (eds). 2005. Community Based Participatory Watershed Development: A Guideline. Ministry of Agriculture and Rural Development, Addis Ababa, Ethiopia

The following excerpt from an interview conducted with REST Director Teklewoini Assefa (2012) sheds more light on this self-image:

"REST tries to create synergy with the people and government at different levels. For example, if you take Soil Water Conservation... I hope you have seen all the checkdams all over Tigray; we brought over the technology to Tigray from India. Between 1985-87, we demonstrated checkdams in big gullies in Tigray and they automatically changed into water bodies."

Further, the government's comparative advantage is seen as lying in its resources and agency that are needed to implement and scale up ideas that work.

"Then we sold this idea (checkdams) to the government as a practical solution. If this has to be scaled....REST cannot scale it up because of our budget limitations. So you see that the government has been scaling up check dam construction since 1989, which has turned many more gullies into water bodies."

It is easy to see that while the government views the big NGO as one of the important partners in implementing natural resource management and spreading know-how about related technologies, the NGO views itself as the dynamic agency at the forefront of transfer of new knowledge. However, there are two distinct points on which both agree:

1) In Ethiopia, NGOs—among a number of other agencies—are key to the process of natural resource management given the substantial resources, expertise and experience they possess.
2) Nevertheless, with all its resources and authority, it is the government which is best placed at scaling up technologies that work. So government uptake is key to whether new knowledge/solutions are able to realise their potential.

2.5 Technology and Knowledge Transfer and Role of the Private Sector in Ethiopia

Private sector and the uptake of technology

In Tigray, as in most of Ethiopia, the private sector is small, and concentrated in the services sector. Besides, it is largely informal which means most enterprises are small, employing less than 5 employees[11]. This indicates a low capacity of the private sector to scale up, innovate and help establish the necessary supply chains when a technology is introduced in the region and demonstrated to be worth adopting.

When check dams were introduced in the region and demonstrated to be effective, scaling up their use to treat gullies was much hindered by the lack of local entrepreneurs who could take up the manufacture of gabion meshes. At some point REST, the local NGO, took it upon itself to set up a gabion factory (1991) [12]. It now has several units in various parts of Tigray. However, they serve less as enterprises that respond to market demand, and more as producers of an input necessary to REST's (and the government's) ongoing work.

[11] 'The World Bank' (2009) Ethiopia Towards the Competitive Frontier: Strategies for Improving Ethiopia's Investment Climate

[12] Personal Interview with Teklewoini Assefa, Director, Relief Society of Tigray (2012)

Private sector and diffusion of knowledge

One area in which the role of private sector has increased in Ethiopia is technical training. This happens through designated Technical Vocational Education and Training (TVET) centres in Ethiopia. In the context of Natural Resource Management, TVET centres are important as they serve to train the youth into becoming mechanics, repairmen and Development Agents who go on to take places as implementers and managers of water harvesting/soil conservation/watershed management interventions.

TVETs have largely been set up and run by the federal Ministry of Education. However, in recent years there has been a massive increase in the number of private TVET providers (licensed by the government). Government sources estimate that private operators provide 30% of all TVET in Ethiopia, while private operators themselves put this figure at 50%[13].

Even the lower estimate of 30% juxtaposes interestingly with the net increase in enrolment for TVET programmes in 2008, at 30.5%[14]. The following tables suggest that about half of all TVET students in Ethiopia were enrolled in private institutions[15].

Table 3-2 TVET Government Graduates by Region and Level

Region	Level										Total		
	1		2		3		4		5				
	M	F	M	F	M	F	M	F	M	F	M	F	Total
Tigray	2	19	34	87	569	504	1280	1556	2	17	1887	2183	4070
Afar	0	0	11	5	82	162	42	19	88	38	223	224	447
Amhara	97	149	979	1096									
Oromoya	242	292	1148	935	5152	3073	7751	4973	26	6	14319	9279	23598
Somali	0	0	43	10	174	53	14	10	0	0	231	73	304
Benishangul-Gumiz	0	0	0	0	0	0	0	0	0	0	0	0	0
SNNP	161	234	593	465	1971	1890	362	117	0	0	3087	2706	5793
Gambella													
Harari	0	0	0	0	0	0	132	147	0	0	132	147	279
Addis Ababa	150	232	472	830	1921	1302	800	981	523	268	3866	3613	7479
Dire Dawa	0	0	0	0	121	58	381	361	0	0	502	419	921
Total	651	907	3282	3437	15000	14016	11322	8489	647	312	30872	27161	58033

Source: Education Statistics Annual Abstract, 2010/11 (MOE, 2010)

[13] Krishnan, Pramila and Shaorshadze, Irina (2013) *Technical and Vocational Education and Training in Ethiopia,* Working Paper, International Growth Centre: London

[14] 'Ministry of Education' (Government of Ethiopia) (2008) *National Technical and Vocational Education and Traing (TVET) Strategy*

[15] 'Ministry of Education' (Government of Ethiopia) (2010) *Education Statistics Annual Abstract.* Addis Ababa.

Table 3-3 TVET Non-Government Graduates by Region and Level

Region	Level										Total		
	1		2		3		4		5				
	M	F	M	F	M	F	M	F	M	F	M	F	Total
Tigray	0	0	0	0	476	95	945	1224	13	38	1434	1357	2791
Afar	0	0	0	0	0	0	0	0	0	0	0	0	0
Amhara	51	104	326	590	1925	3301	3923	5100	27	21	6252	9116	15368
Oromoya	24	60	65	156	2512	1335	7462	6588	0	0	10063	8139	18202
Somali	0	0	0	0	0	0	60	27	0	0	60	27	87
Benishangul-Gumiz	0	0	0	0	65	58	141	137	0	0	206	195	401
SNNP	84	24	87	57	4509	3013	2903	1662	0	0	7583	4756	12339
Gambella													
Harari	0	0	0	0	39	10	355	203	0	0	394	213	607
Addis Ababa	535	1108	308	543	508	1044	2559	2159	111	112	4021	4966	8987
Dire Dawa	0	0	0	0	62	2	386	306	0	0	448	308	756
Total	694	1296	786	1346	9620	8763	17789	16182	138	133	29027	27720	56747

Source: Education Statistics Annual Abstract, 2010/11 (MOE, 2010)

The public perceives government TVET institutions to be of a higher quality than private ones, and this perception is not entirely unfounded[16]. Nevertheless, the sheer number of enrolments in private institutions (despite the fact that they charge a fee while government TVET centres are free) shows that there is a significant gap between the demand and supply of technical education that they fill.

[16] Krishnan, Pramila and Shaorshadze, Irina (2013) *Technical and Vocational Education and Training in Ethiopia,* Working Paper, International Growth Centre: London

3. Knowledge transfer in Burkina Faso

Burkina Faso has been for long a country where Water Harvesting is considered a fast developing track endorsed by the government and by other non-governmental actors. The first impulse was given by the dramatic droughts that hit the area in the '70s. In the 80's the campaigns against desertification got a new impulse with the advent of participatory approaches introduced by local and international NGOs. At the same time bilateral and multilateral cooperation initiatives took place in the country following different paths of knowledge transfer and community participation. In this chapter we look at different paths to transfer knowledge in the Burkinabe society and in relation to rural development and spreading of Water Harvesting technologies.

The main question to answer is: What is the basic mechanism of knowledge transfer between stakeholders that boosted the uptake of water harvesting technologies?

3.1 Big projects and the paradigm shift in rural extension

In the 1960s' the GERES project represent the first large scale, multi-donor effort with the aim of controlling soil erosion[17]. In the project earthen bunds were applied on 120.000 hectares, but the involvement of farmers was really limited and it turned out to be one main cause of failure. As a consequence farmers would not maintain the structure and often destroyed them[18]. In the 70s the same approach was followed by another multi-donor project called FDR. Also in this case a big portion of land (60.000 hectares) was treated with mechanized soil bunds, but as in GERES the communities were not involved and rather started to dislike the interventions. Also technically the bunds were designed to drain water rather than retaining it. This fact – in the semi-arid environment of central Burkina Faso – contributed to a low adoption, and mistrust of the introduced technologies. Mathieu Ouedraogo briefly describes the GERES project:

> *"The bunds built by the GERES project were not accepted. The people did not accept them as being for themselves. The bunds seemed to appear out of nowhere and people did not know what they were for so they were left unused and in facts, in certain areas, the bunds even contributed to increase the erosion pressure"*[19]

The major change in approach occurred first with the PAF (Project Agro Forestier) project with the support of OXFAM. For the first time a participatory approach to water harvesting was adopted to introduce contour stone lines/bunds in Yatenga province. In the following 15 years the technology was then widely and successfully promoted by various initiatives. Recently the portfolio of interventions has been broadened and picked up by various international projects such as PEDI (1982-2000), PATECORE (1988-2006), PSB (1989-2005).

Positive national policies enabled a conducive environment for the introduction of water harvesting (Reij and Steeds, 2003). In general the government is really supportive to these kinds of initiatives and the restoration of soil fertility and fight against desertification are predominant in the agenda.

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[17] Critchley, W. (1991). *Looking after our land*. Soil and Water Conservation in Dryland Africa. OXFAM.

[18] Critchley, W., & Gowing, J. (2012). *Water Harvesting in Sub-Saharan Africa* (pp. 1–218). Earthscan.

[19] From the interview contained in "Looking after our land". Retrieved from http://thewaterchannel.tv/en/videos/categories/viewvideo/866/agriculture/looking-after-our-land on the 15th of November 2013.

This is outlined in the Sustainable Agriculture Policy (DPDAD) developed in 1997. Two basics tools in this respect are the National Strategy for Integrated Management of Soil Fertility (SNGFS) and the Plan of Integrated Soil Fertility (PAGIFS) that were adopted in 1998. In recent years farmers were involved in participatory processes to select, adapt and implement several WH technologies. The final word on which technology to adopt was always of the community and that created a common sense of ownership and understanding. Nowadays, it is common sense in the central plateau of Burkina Faso that agricultural activities are no sustainable without the adoption of some forms of water harvesting[20].

Knowledge Transfer Mechanisms

Extension service is a major tool of both Governmental and Non-Governmental Organizations for the promotion and scaling up of Water Harvesting technologies. Nevertheless, funding has been and still is the main hindering factor of the magnitude of the extension service. For this reason lately Farmers based extension became a main tool for scaling up water harvesting because of its high acceptance and low costs. Farmer innovators and farmer trainers are nowadays a common approach that is reaping excellent results.

The success of water harvesting uptakes is strictly linked with the development and spreading of traditional technologies such as the Zai planting pits. Zai were improved by few **innovative farmers** in the 80's and spread in the country widely. The most interesting factor regarding knowledge transfer is the creation of informal networks of farmer innovators that developed, tested and applied these innovations. The farmers gained an improved livelihood from these developments, but also an improved position in the local community, where these knowledgeable individuals are enabling others to pick-up water harvesting with little or no return for themselves. The importance of farmers groups were a participatory process is the practice more than an exception has become clear in the course of the years. Nevertheless, farmers groups suffer of unbalanced representation of the weaker community groups. In fact, it is often the case, that only the most influential and better off individuals have a strong voice in these groups. Therefore there is a risk that weaker households might be marginalized even more.

Farmers in the northern provinces actively promoted water harvesting technologies following three main farmer extension models[21]:

1. Since 1984, Yacouba Sawadoga started ***Market Days*** events to promote and discuss the Zai farming systems within the community. These events take place twice a year and now attract big numbers of farmers from over 100 villages. One *market day* takes place shortly after the harvest and the second takes place just before the rainy season. Each *market day* has a specific focus that is often concentrated on practical topics (e.g. growing Sorghum using Zai pits). Additionally, there is always a display of tools that can be used to dig zai. This allows farmers coming from different regions to learn which are the best tools and related practice to introduce water harvesting in their farms. During the year Yacouba receive many

[20] Critchley, W., & Gowing, J. (2012). *Water Harvesting in Sub-Saharan Africa* (pp. 1–218). Earthscan.

[21] Various. (2001). *Farmer Innovation in Africa*. (C. Reij & A. Waters-Bayer, Eds.)A Source of Inspiration for Agricultural Development. Earthscan.

visitors from the region and from abroad, this would cost him a big amount of time set aside from farming activities. To balance his time between spreading knowledge and his everyday activities he decided to make the visitors contribute to his farming activities. The arrangement is that every visitor has to either dig some zai pits or to plant a tree seedling. Yakouba main incentives - which drive his capacity building activities – are his innovator status and public recognition.

2. Also in the Yatenga region, Ousseni Zorome started in 1992 the ***Zai school*** model to promote the Zai pit system. He first started by rehabilitating a small plot of land using the zai technique with a group of local farmers. Following the successful trial he started to organize more farmer groups. Each farmer group would be trained on the job by rehabilitating a plot of degraded land and by sharing the yield. On the side Ousseni would organize trainings on his plot or on the plot of famers belonging to a zai school group. Ousseni received very small support to initiate the activities and he usually goes around with his own motorbike and purchase fuel with his own resources. At the moment there are 21 zai schools and more are being set up.
3. In the village of Gourcy, Ali Ouedraogo introduced the ***Teacher-student*** extension model. Ali is training farmers in five villages near Gourcy and he visits them frequently to work with them in order to show them how he manages the zai system. The trained farmers become in turns trainers themselves. Not only the farmers learn about the zai system but they also adapt the technology to fit the context and their specific needs. Ali and his farmers are not paid for their extension service. Self-esteem is a big enough reward for them.

Nowadays farmers appear to be more conscious and knowledgeable about water harvesting and its importance for improved yields. They see a growth in yields when applying WH and see the effect on the water tables and on the regeneration of indigenous vegetation, the management of livestock among others. Finally it has been proved in the years that the platform in which innovation has been taken up most effectively is when farmers organized themselves in groups for transferring technologies and share experiences. Strengthening these organizations in fact often leads to better management of natural resources and improved social cohesion[22].

Also **research** has had a practical impact in the adoption of water harvesting in vast areas of Burkina Faso. The scientific results are visible as academic publications, but also were reflected in the adoption in the fields[14]. On the other hand, funding is also in this case hindering the expansion of these activities and in particular the follow up on projects and the monitoring of activities.

Training also played an important role in adoption of water harvesting technologies**. On the Job training** has been adopted in several programs and was initially adopted by NGOs.

[22] Critchley, W., & Gowing, J. (2012). *Water Harvesting in Sub-Saharan Africa* (pp. 1–218). Earthscan.

3.2 NGOs putting water harvesting into practice

In Burkina Faso NGOs play a central role for the support of Water Harvesting uptake. Women support program managed to improve the situation of women and their power within communities. At the same time various programs were successful to promote a wide range of approaches and technologies such as: water harvesting, agroforestry, livestock husbandry, village water and micro-credit. Two fields that are perceived of needing stronger efforts are building of social capital and building local capacity. For instance management committees of village lands and decentralized public technical services require further strengthening (Critchley 2012).

Box: Theatre plays and Agriculture Extension

Burkinabe culture has a rich culture and heritage involving – among other things – theatre plays. In the country some artists/directors are emerging as real innovators and promotors of social change through their plays. A vivid example is the Atelier Theatre Burkinabe (ATB) under the direction of Prospere Kampaore[1]. The ATB advocates the use of participation in a way that the barrier between the actors and the spectators is broken and interaction occurs. The plays are followed by small discussion with the spectators that can openly suggest how they would like the play to evolve. Consequently the actors improvise and enact the suggestions from the public[2]. This kind of approach has proven to be successful to promote also good agricultural practices (INERA)[3], but also to support Campaigns to control HIV-AIDS and to empower women in rural communities[4].

[1] atb.bf, retrieved on 10 November 2013
[2] Banham, M., 1995, The Cambridge Guide to Theatre
[3] Personal communication, 2013, WAHARA project
[4] http://www.gret.org/2012/10/the-theater-forum-a-solution-for-gender-related-obstacles-in-burkina-faso/?lang=en, Retrieved on 10 November 2013

4. Knowledge transfer mechanisms in Tunisia

At 165,000 square kilometres and with a 10.7 million population, Tunisia is a categorically 'small country.' At the same time, it is remarkably diverse in many ways. Geographically, the green mountainous Dorsal and Tell regions in the north contrast with the semi-arid/desert south. In between, the 'Sahel' coastal plains along the eastern Mediterranean coast and the Steppes south of Gafsa complete a continuum of sorts. The national economy is also fairly diversified: between agriculture (12% of GDP), industry (26% of GDP) and services (62% of GDP)[23].

Tunisia is a water stressed country, with a renewable water availability of 486 cubic metres per capita- well below the average of 1200 cubic metres per capita in the larger MENA region.[24] Besides, excessive groundwater extraction near the coastal regions have led to increased salinization of many of the freshwater sources, reducing further the amount of water fit for various uses.

Despite accounting for 12% of the GDP, the agricultural sector is the biggest water user, responsible for 86% of the withdrawals from Tunisia's known water resources in 1996. [25] The Ministry of Agriculture estimates the demand for water to stabilize somewhere between 2.7 cubic kilometres and 3.1 cubic kilometres by 2030. Therefore, there is much emphasis on achieving efficiency in water use and developing new sources to expand supply, especially in the farm sector. This is also reflected in the agricultural research agenda and forms of incentives/support extended by the government to farmers.

4.1 Government and Agricultural Research

Agriculture is crucial to the Tunisian economy even outside the context of water use and water scarcity. The importance of agriculture to the Tunisian economy is underscored by the fact that it employs about a quarter of the workforce, thus supporting livelihoods and controlling urban migration. [26] Therefore agriculture, and agricultural Research and Development in particular, figure high on the priority list of the federal government. Agricultural research is primarily funded by the government. Most of it is overseen by the Agricultural Research and Higher Education Institute (IRESA)[27], an institution established in 1990.

The primacy of agricultural research in Tunisia dates back to the end of the 19th century, when The Livestock Laboratory was established in 1897 by the then colonial government. A number of research institutions were set up thereafter, around a variety of themes including agronomy, reforestation, 'rural engineering,' olive plantation and fisheries. In 1990, the federal government set up Agricultural Research and Higher-Education Institute (IRESA) as part of the World Bank-supported Agricultural Research and Extension Project (PRVA)[28], to administer and coordinate the research

[23] CIA: The World Factbook, *The World Factbook: Tunisia,* viewed November 28, 2013 <https://www.cia.gov/library/publications/the-world-factbook/geos/ts.html>

[24] Shetty, S 2013, 'Treated Wastewater Use in Tunisia: Lessons learned and the Road Ahead' in C.A. Scott, N.I. Faruqi and L.Raschid-Sally (eds) *Wastewater Use in Irrigated Agriculture: Coordinating the Livelihood and Environmental Realities,* CAB International, p.p. 163-172

[25] Earth Trends, The Environmental Information Portal , *Water Resources and Freshwater Ecosystems- Country Profile-Tunisia,* viewed November 26, 2013.

[26] Moufida Touayi, 2004, 'Proceedings,' *Sub-regional Workshop on Application of ICT for Enhancement of Extension Linkages, Coordination and Services*, Hammamat, 22-24 November

[27] http://www.iresa.agrinet.tn/

[28] Various, 2003, *Implementation Completion Report (SCL-42780) on Loan in the Amount of US$ 42 million to the Republic of Tunisia for a Second Agricultural Sector Investment Loan*, The World Bank, Washington DC

being done through all these institutions. This forms the bulk of the research being done in Tunisia. [29] Further, IRESA is entrusted with:

- Promoting agricultural research through the establishment of linkages between agricultural research and higher education institutions on the one hand, and, on the other hand, agricultural extension and the producers;
- Setting up agricultural research programs and allocating the necessary budgets for their implementation;
- Follow up, coordination and evaluation of program implementation;
- Ensuring that agricultural research and higher education institutions serve agricultural production.[30]

This points to an extensive network of research that extends into a variety of themes, which befits the variegated nature of Tunisia's geography and agro-climatic regions. There is an inherent danger in such a structure of the whole gamut of agricultural research being driven by a central agenda (IRESA's), thus limiting the extent to which the research agenda is informed by and relevant to local realities. In response to this possibility, (through a process that began in 1995) IRESA decentralized into seven regional branches. The seven regions correspond to Tunisia's seven agroecological zones, each representing a distinct scenario with respect to (among other aspects) hydrology and water use.

4.2 Government and Agricultural Extension

Around the time that IRESA was set up; during the last years of the 7th federal 5-year plans (1986-90), extension territorial cells were set up at the regional level and the Agricultural Training and Extension Agency was set up at the central level. A 5-year national agricultural extension development initiative started in 1991 as part of the 8th 5-year plan (1990-94). These efforts continued and have culminated into a three-tier system which is currently in place:

- At the central level: the Agricultural Extension and Training Agency (AVFA) is in charge of mass agricultural extension, support, follow-up and coordination of field extension
- At the regional level: the Agricultural Development Regional Commissions (CRDA) is in charge of field agricultural extension through
- Extension Territorial Cells (CTV) and the Agricultural Radiance Centres (CRA)

What has this system amounted to? In the absence of a comprehensive evaluation, the following numbers provide some indication with regards to the reach of the system and the volume of its activities (as per government figures available till 2003-04) [31]:

1) **Number of active extension workers:** The field-level agricultural extension network comprises of 854 workers. This includes 593 personnel who work directly with farmers. They are helped by 261 personnel in planning their activities, administration and coordination with regional and federal government units.

[29] Lasram, M. and M. S. Mekni. 1999. *The national agricultural research system of Tunisia. WANA NARS Study.* International Center for Agricultural Research in the Dry Areas, Aleppo, Syria:
[30] Moufida Touayi, 2004, 'Proceedings,' *Sub-regional Workshop on Application of ICT for Enhancement of Extension Linkages, Coordination and Services*, Hammamat, 22-24 November
[31] Moufida Touayi, 2004, 'Proceedings,' *Sub-regional Workshop on Application of ICT for Enhancement of Extension Linkages, Coordination and Services*, Hammamat, 22-24 November

2) **3,500 information days** (covering 43,000 farmers) annually
3) **2,300 practical sessions** facilitated by extension workers or scientists (covering 19,300 farmers) annually
4) **500 demonstration plots** for the benefit of 3,100 farmers
5) **186,000 individual field interventions**

In addition, there are outputs produced and disseminated through the mass media:

- 180 TV spots
- 365 radio programmes
- 144 radio releases

(average annual numbers)[7]

These numbers, even if insufficient, are certainly substantial. In any case, the underlying system provides ample scope for further expansion of extension services within the existing framework.

4.3 Knowledge Creation, Knowledge Transfer

4.3.1 Hierarchies of knowledge systems and Blind Spots

The strong focus and investments by successive Tunisian federal governments into generating quality, relevant research and reaching it out to farmers through an expanding extension network is certainly noteworthy and even laudable. As mentioned before, the present system forms a good basis for further expansion and innovations.

So what areas does the federal government, that put the present system in place over more than twenty years, recognise as priorities for improvement? At a workshop organised by the FAO (in 2003), representatives of the Agricultural Extension and Training Agency (AVFA)[32] listed the following as the key focus areas of the 'Agricultural Extension Enhancement Project':

- Conception and implementation of a programming, follow-up and assessment approach;
- Launching of computerisation in the extension system at the central and regional levels;
- Updating and enhancement of the programming approach by including the qualitative aspect (programming by objective) particularly at the level of components of the intensive extension campaigns.

The concerns listed lie very much within the configuration of the existing extension system, focusing on expanding and improving the efficiency of the system already in place.

A different set of concerns question some very fundamental assumptions on which the present system is based. What is agricultural knowledge? Who creates it? Who is the custodian of such knowledge? Is there an assumption that transfer of such knowledge takes place from 'scientific' 'research' institutions towards farmers? Is it worth examining that assumption?

The Indigenous Soil and Water research programme (ISWC), a collaboration between the Vrije Universiteit, Amsterdam (The Netherlands), ETC Ecoculture (The Netherlands) and Institut des

[32] Moufida Touayi, 2004, 'Proceedings,' *Sub-regional Workshop on Application of ICT for Enhancement of Extension Linkages, Coordination and Services*, Hammamat, 22-24 November

Regions Arides (IRA, Tunisia)[33] raised such questions. The programme began in Tunisia in 1997. Through a series of workshops, awareness raising activities and field research, it sought to instil in scientists and extension agents the value of participatory approaches to research and extension.

The programme highlighted the inclination among scientists and agriculture extension agents in Tunisia to regard what is considered formal 'scientific' research-- produced in research institutes and reviewed/approved by the international scientific community—as the sole form of agricultural knowledge worth passing down to farmers through extension efforts. With this attitude, one valuable source of information that was definitely being overlooked and underutilized was knowledge generated and shared among farmers through their daily experiences in the field. *'Why go to farmers for inspiration? Have researchers lost their own creativity?'* [34] These frequently-arising questions represent scientists' scepticism about the more traditional knowledge systems. Such attitudes create blind spots that are against the very spirit of scientific enquiry. They overlook, for example, Tunisia's rich rainwater harvesting heritage that pre-dates modern scientific research by hundreds of years.[35]

Another key aspect of Tunisian farming systems that fall into these blind spots is the role of women, who play a key role in rain-fed crop production. The enormous workload on women in rural areas and the need for them to multitask drive them to innovate and achieve economies in water use (so they have to spend less time fetching water). Recent studies [36] have brought to light the high degree of innovation they bring to their work everyday: such as fashioning water saving devices out of household objects, efficient cropping techniques, and customized cut-and-carry feeding practices, just to name a few. The predominantly male scientific and agriculture extension communities tend to overlook these stories, as cultural norms in Tunisia severely restrict communication between opposite sexes. A more participatory research/extension system would therefore involve a greater representation of women in the cadre.

Agriculture extension, therefore, is currently envisaged as a unidirectional process of transferring scientific knowledge to farmers. There isn't much emphasis within the system to take into account traditional knowledge and practices prevalent among farmers, and on establishing and institutionalising processes that facilitate farmer-to-scientist or framer-to-farmer learning. Agricultural science and agricultural practice are left poorer for lack of such processes. In addition, farmers are disempowered and their ability/willingness to innovate is much eroded.

4.3.2 Institutional Disincentives against Learning from Farmers

Agricultural research is ideally instrumental, contributing towards solving problems that farmers face. The process, therefore, is served very well by inputs from farmers at various stages: data collection, analysis, technology development, implementation, impact assessment etc. However,

[33] IRA is affiliated to INESA. It is categorically a government organization. (http://www.ira.agrinet.tn/ang/)
[34] Nasr,N, 2002, 'Impact of the farmer innovation approach on the attitudes of skeholders in agricultural development in Tunisia,' in Chris Reij & Ann Waters-Bayer (eds) *Farmer Innovation in Africa: A Source of Inspiration for Agricultural development,* Earthscan, UK, pp. 325-330
[35] Video: *'Rainwater Harvesting in Tunisia'*, produced by Sapien Productions and 'Centre de Recherche et des Technologies des Eaux, Tunisia, Viewed on November 29, 2013 <http://thewaterchannel.tv/en/videos/categories/viewvideo/597/water-harvesting/rainwater-harvesting-in-tunisia>'
[36] Nasr N, Chahbani, B & Reij, C, 2002 'Women's innovations in rural livelihoods in Arid Area of Tunisia,' in Chris Reij & Ann Waters-Bayer (eds) *Farmer Innovation in Africa: A Source of Inspiration for Agricultural development,* Earthscan, UK, pp. 132-135

incentives available to scientists in order to advance their careers are stacked too heavily towards doing research that would get published in scientific journals.[37] This creates bias towards certain topics of research and certain research methodologies that are not necessarily informed by farmers' concerns or involve them in the process.

4.4 Conclusion

The length and breadth of the agricultural extension network in Tunisia, and its prudent decentralization, speak of an extensive infrastructure for knowledge transfer backed by a government that places much emphasis on improving the efficiency of the agricultural sector. The ground is well prepared to introduce water harvesting technologies through the channels of government-affiliated research organisations, and extension agents linked to research organisations.

However, there is much scope for further enquiry into channels of knowledge transfer that facilitate learning between farmers, and those that could help inform scientific research by the vast amount of knowledge generated and held by farmers. In this regard, special emphasis needs to be placed on identifying and recognising the contribution of women to agriculture, water harvesting and related activities. A strong case can be made for identifying opportunities to involve women in promoting water harvesting technologies (WHTs) in Tunisia.

Lastly, it must be mentioned that the issues of inadequate farmer participation and scientific bias are by no means specific to Tunisia. They are known to exist in developing country contexts around the world, even if in varying degrees and in different forms. This also means that participatory methods known to have worked in other contexts can be considered for adoption in the Tunisian context. Cases from South Asia and East Africa have demonstrated how involving farmers in agricultural research (using the Farmer Field School approach, for example[38]) is not just a tool for empowerment, but also research methodology that can achieve high resolution in data collection and high efficiency in trial and implementation of new technology.

With regards to participatory research and implementation of WHT in Tunisia, Institut des Regions Arides (IRA) is well positioned as the WAHARA consortium partner in Tunisia. This is based on the Indigenous Soil and Water Conservation (ISWC) research programme that was a pioneer of sorts in raising some fundamental questions related to knowledge transfer and power relations between research institutions, extension agents and farmers. Especially in view of the fact that IRA is very much a government-affiliated institution, its focus on participatory research and technology transfer could be invaluable for WAHARA to inventorize and create policy traction for WHT in Tunisia.

[37] Nasr,N, 2002, 'Impact of the farmer innovation approach on the attitudes of skeholders in agricultural development in Tunisia,' in Chris Reij & Ann Waters-Bayer (eds) Farmer Innovation in Africa: A Source of Inspiration for Agricultural development, Earthscan, UK, pp. 325-330

[38] Global Farmer Field School Network and Resource Centre, *Home Page,* Viewed November 30, 2013 <http://www.farmerfieldschool.info/>

5. Knowledge transfer in Zambia

5.1 Policy in to action in Zambia

The National Agricultural Policy in Zambia 2004 – 2015 is the current document that describes the vision and policy framework for the agricultural sector also with regards to service provision (IFPRI[39]). It is important however to understand a bit of the farming landscape in Zambia, before reflecting on the policies that have been developed to develop the sector.

Zambia has one of the best land and water endowments in Africa that constitute a huge agricultural potential. Currently 15% of the Zambia's arable land is being cultivated of which 85% is rainfed agriculture.

Zambia's farming is carried out by few large scale farmers that are particularly concentrated along the length of the Great North Road, from Livingstone following, Mazabuka (large sugarcane) Kafue, Lusaka, Kabwe, Mkushi (so called 'bread basket' of Zambia), and a little further north towards Mpika. This farming is commonly high-tech and high-input, reliant on subsidized fertilisers and high yielding varieties, as well as that most farmers will also irrigate parts of their land during the winter/ dry season for second crops. Specific soil and water conservation practice is not carried out, although most large scale farmers will either maintain (private) surface water reservoirs or tubewells, to use the water for irrigation.

Often in stark contrast is the livelihood and farming practice of small scale farmers in Zambia. It is estimated that about 40% of rural households are engaged in solely existence farming (IFPRI, ibid). Farmers: often use recycled seed; are commonly reliant on fertiliser through cooperatives or the Fertilizer Support Programme (FSP), although supplies are not always timely (too late for a cropping season) and the price is often too high for farmers to be able to apply sufficiently or at all; and traction power/ cattle is not a common asset for small holders, limiting the cultivated area as well as that households cannot count on being able to sell cattle when the need for food or cash is high. Hence the farmers performing subsistence farming in Zambia are highly vulnerable to crop failures, the socio-economic differences are enormous when comparing large scale farmers and urban or Copperbelt dwellers.

With this as back-drop the landscape of farming extension service providers, farming knowledge and knowledge sharing and the national policies will be explained. Underneath in box 1 a summary is given of the national agricultural policy, in particular the provision of agricultural extension services.

[39] Online Agricultural Extension and Advisory Services World Wide, Facilitated by IFPRI (http://www.worldwide-extension.org/africa/zambia/s-zambia)

Box 1: National Agricultural Policy 2004 – 2015, Extension Services

Objective: To provide efficient and effective crops extension and technical services, especially through participatory approaches, to assist farmers increase agricultural production and productivity and diversify crop production and utilization.

Specific objectives:
i) To extend proven technological messages and innovations to resource poor farmers including women and young farmers so as to increase agricultural production.
ii) To provide liaison and links between farmers and farm support organizations responsible for credit, marketing and research.
iii) To support farmers gain management and marketing skills in order to operate on a commercial basis.
iv) To facilitate the transfer of and improvements in on-farm crop handling and storage technologies in order to minimize post–harvest losses.
v) To promote and ensure availability of good quality food to enhance nutrition, especially among the poor and vulnerable communities.

Strategies
i) Promote and strengthen farmer groups and farmer field schools as targets for technology transfer.
ii) Create and strengthen the zoning of agricultural camps in order to improve service delivery and infrastructure development.
iii) Use electronic and printed media as communication tools to support extension information delivery.
iv) Promote and encourage the involvement of the private sector and NGOs in the provision of extension services.
v) Promote crop diversification and use of improved technologies.
vi) Promote gender responsive agricultural extension services.
vii) Facilitate delivery of skills training and technology transfer to small scale farmers using Farmer Training Institutes at staff level and Farmer Training Centres at farmer level.
viii) Promote food crop processing and utilization.

Institutional Framework
The Ministry of Agriculture and Co-operatives will provide extension and information through its network at national, provincial, district, block and camp levels. Farmer organizations, the private sector, Non-Governmental Organisations, and Community Based Organizations (CBOs) are expected and encouraged to provide extension services to farmers.

To provide an outline, we first have a look at the above government policy. This national agricultural policy was very much written in line with system of liberalisation aimed at bolstering private sector participation (including in provision of extension services) that started in the beginning of the 1990's (IFPRI, ibid). This particularly comes forward in the specific objectives that encourage private and NGO involvement in agricultural services provision, as well as that the (/some of the) objectives particularly aim to improve the marketability of crops of small farmers, i.e. to promote: crop diversification, improved storage, market access, credit facilities etc. The policies aim to support the shift from subsistence agriculture (farming of staples such as maize) to more diversified agriculture. The policy creates distinct space for both government lead extension services and farming learning, as well as extension and services provided through farmer unions, cooperatives or by agri-based

industries (e.g. by ginneries). Farmer training however is separately mentioned as a service to be facilitated by the government but to be given by and through (NGO/ private) farming training institutes or farming training centres.

With regards to government extension services the Ministry of Agriculture and Cooperatives (MACO) uses its staff from the national level down to the field level to implement extension programs. Zambia's administrative division is as follows:

- at country level there is the ministry/ MACO,
- then it is divided into provinces,
- provinces are divided into districts, and districts have agricultural offices that gather all agricultural data and also house subject matter specialists
- districts are divided into blocks, and each block will have a block extension officer (BEO), or either;
- each block is divided into camps and at least each camp has a camp extension officer (CEO)

Zambia's public extension comprises of 742 staff members and is managed by a team of 308 senior staff (IFPRI, ibid). Government extension staff at field level (CEOs) commonly only has a secondary school diploma, whom can fall back on district subject matter specialists who commonly hold B.Sc. degrees.

As mentioned the policy (and practice) allows for a wide range of private organisation or NGOs to be involved in the agricultural sector. The various organisations that are also involved in farmer learning include: Zambia National Farmers Union, Conservation Farming Unit, ZamSeed, Ginneries (such as China-Africa Cotton or Dunavant), World Vision, Development Aid from People to People (DAPP), Golden Valley Agricultural Research Trust (GART), etc.

In chapter 5.2 the practice with regards to extension, farmer to farmer learning and knowledge exchange with regards to water harvesting and soil conservation is described.

5.2 Policies and guidelines put into practice in Zambia

As mentioned in chapter 5.1 there is tremendous difference in Zambia between large scale and small scale farming as well as between the socio-economic situation of households engaged in both types of farming. Unfortunately, since no agronomic surveys or results thereof have been made available to support this part of the writing, we limit the underneath to what was found through a quick survey and reports that were part of other another study in Zambia.

Small holder farming in Zambia can still very much be characterised as subsistence farming. The following issues with regards to farming can be noted:

1. Climatic variability: although Zambia is endowed with plenty rainfall in most parts of the country, to sustain a rainfed crop; rainfall variability, i.e. the start of rainy seasons and temporary periods of drought during important stages of crop growth, seriously affects the soil moisture available for plant growth and often leads to low production or entire failing of a crop.

2. Low soil fertility: although large parts of Zambia can be characterised as arable land, the soils are not inherently fertile. Most lands after clearing are perceived as fertile by small-holders but following several seasons the land quickly degenerates as soils are shallow and minerals are either

converted into biomass or drained. A common problem is that soils that are already prone to becoming acidic are inappropriately fertilised, as fertilisers such as DAP and Urea are simply applied in a 2:1 ratio (as how the government also allows farmers to buy them), rather than adapting proper ratios of fertiliser and carrying out soil conservation measures to ensure soil fertility.

3. Subsistence nature of small-holder farming: although land is not a limiting factor for most farmers in Zambia (even small-holders) labour to cultivate the land is. Furthermore there is little ownership of cattle in Zambia which means that most lands are prepared only by hand (hoe farming). This nature of farming limits the possibilities of farmers to invest and expand cultivated area or diversify cropping patterns.

4. Limited market access for small-holders: although Zambia has large agricultural potential and it borders 8 countries where crops could be exported to, the markets are still very limited. Diversification of agriculture is important although only large scale farmers are able to put sell their crops in the national domain, whereas in remote areas that are not connected to national markets the local market for horticultural crops is quickly saturated at times of harvest (inducing low prices) and inexistent at times when crops are grown.

With regards to current practice a recent study into the uptake of soil and water conservation practices in Zambia (that is still to be published) shows that soil and water conservation do take place by respectively 44% and 10% of the small-holder farmers, see the table below.

Table 1: Soil and water conservation in practice in Zambia (quick scan)

	% of farming households
Soil conservation	44
Soil bunds	83
Terracing	17
Water conservation	10

Of those farmers carrying out soil conservation most of them construct soil bunds in their fields, whereas 17% construct terraces. With regards to water conservation only one-tenth of farmers take measures where one-tenth carries out minimum or zero tillage and a quarter uses mulch on their field (commonly farmers leave crop residue on the fields as mulch). However particularly the farmers that had implemented water conservation measures confirmed that there yields had improved, and understood that this was also a resultant of improved soil moisture.

Knowledge transfer mechanisms:
In general, also following from the quick scan performed in Zambia, farmers acquire the skills and knowledge on water harvesting and SWC through the following, in order of importance:

- through other farmers, or very local farming cooperatives: households members in rural areas in Zambia are commonly member of different types of cooperatives and organisations (small marketing cooperatives, seed recycling, mutual assistance groups, women groups, religious groups, etc.)
- through extension officers: extension officers organise farmer field days, exchange visits, or facilitate visits by private seed or input companies.

- Through NGOs with specific target audience and a specific programme
- Through market players, such as input suppliers, wholesalers or through an outgrowers-scheme

5.2.1 Government putting water harvesting put to practice in Zambia

The Government of Zambia, already recognises in its agricultural policy 2004-2015 that 'the rural farming population is large and widespread making the provision of extension services rather difficult'. This difficulty is also often experienced by the camp and block extension officers in rural areas, as often modes of transportation (or fuel for transportation) are not available and the knowledge level of extension officers varies. Farmers experience as to the quality of extension services through the government vary from camp to camp, where the zeal, skill and knowledge of extension officers determines the level of services.

Water harvesting in the form of dams or micro-catchment, pits or any other forms is not prevalent and is also not distinctly promoted or supported. Although soil and water conservation measures are promoted by the extension officers.

5.2.2 NGOs putting water harvesting into practice in Zambia

The work of NGOs is limited and scattered in Zambia. Programs addressing the most vulnerable groups, i.e. female headed households or households affected by HIV/AIDS do exist although they do not cover the entire country.

The work of GART, also as part of the WAHARA project, includes testing and disseminating results of: Zero tillage, Strip tillage and Ripping with an improved ripper (tiller, automated fertiliser and seeder). These technologies, however more relate to storing rain water in the soils rather than storing the water in dams or surface areas and capturing it from runoff or storing it in the ground. Like the soil and water conservation promoted by the extension officers these technologies aim to bridge dry spells since there is no total lack of water.

Extension performed by GART includes to create awareness through:

- Farmer Field days
- Farmer exchange visits
- Farmer demonstration plots (evidence based awareness creation)

Besides that GART is also involved in Training of farmers and improving manuals for extension workers to cover all (conservation) agricultural practice. Farmers got to know about the new techniques at GART through word of mouth, they have shown interest in the different rippers. This type of unintentional and in-active dissemination promises a good response, since the techniques and opportunities they present apparently already caught the eye of farmers. The advantages as perceived by the farmers to the specific techniques mentioned above are summarised to be:

1. Reducing the amount of labour in farming (the amount of work and the tediousness of work)

2. Saving costs

3. Allowing for timely planting at the moment the rainy season actually starts.

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