Documentation of successful traditional farmers' practices and innovations in agricultural water management in Amhara Region, Case: North Shewa

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Abstract

Farmers' have been innovating new practices since the dawn of agriculture to adjust to their circumstances so that they can maximize or optimize benefits from the use of their natural, human and financial resources. Results of such innovations lead to practices, which are in most cases sustainable, practical and within the limits of their capabilities. Such practices may include areas of soil and water conservation, abstraction and conveyance of water for irrigation, methods of application and scheduling of irrigation water to crops, choice of crops, other agronomic practices for irrigated crops, and management of the water users in making decisions to share water, maintain irrigation schemes, resolve conflict and the like. Farmers in north Shewa have been managing agricultural water for long and have developed practices and innovations. Such successful practices can be made available to farmers in other areas with similar environments for adaptation and adoption to assist the Region's endeavor on developing irrigation-based agriculture to attain food security at household and state levels. This paper tries to describe the traditional farmer innovated and successful practices and assess the potential these practices for the betterment of water management.

Key words Checkdam, Indigenous knowledge, yewuha abat

Introduction

Farmers around the world are aware that farm-level land and water management practices are of prime importance for satisfying the needs of field and vegetable crop. Sufficient water must be present in the root zone for germination, growth and soil microbiological and chemical processes that aid in the mineralization of nutrients. Therefore, they endeavor to optimize the water supply of their crops within the limits of their knowledge and the farming operations practiced. They have developed some sort of on-farm water management practices as a result of continuous experimenting.

They have been innovating new practices since the dawn of agriculture to adjust to their circumstances so that they can maximize or optimize benefits from the use of their natural, human and financial resources.

Results of such innovations lead to practices, which are in most cases sustainable, practical and within the limits of their capabilities. Such practices may include areas of soil and water conservation, abstraction and conveyance of water for irrigation, methods of application and scheduling of irrigation water to crops, choice of crops, other agronomic practices for irrigated crops, and management of the water users in making decisions to share water, maintain irrigation schemes, resolve conflict and the like. Some innovations and adoption may take place on individual farms quite often community action leads to large-scale adoption.

The Amhara National Regional State is emphasizing on developing irrigation-based agriculture to attain food security at household and state levels. To this effect various irrigation projects have been implemented. Therefore, it is important that appropriate technologies are available for adoption by the farmers. The status of formal research in Amhara is in its nascent stage despite the fact that farmers in the State have been practicing irrigation for centuries, which requires documentation and understanding farmers' knowledge of irrigation water management and the practices used successfully. Such successful practices can be made available to farmers in other areas with similar environments for adaptation and adoption. This can significantly reduce the time usually needed for formal research to come up with appropriate solutions. On the other hand, understanding the principles behind the successes of the practices can help researchers and extension officials in evolving new technologies or practices. Over all, the process can reduce the time and cost involved in developing appropriate and sustainable technologies to the farmers. It can also facilitate improving some of these practices through infusion of knowledge of scientists and extension officials. Therefore, this experiment was conducted with the objectives of describing the traditional, farmer innovated and successful practices in detail, context of their development, benefits from such practices and their strengths and weaknesses and assessing potential to improve the performance of such practices through formal on-farm and/or on-station research

Materials and Methods

For this study, the following definitions and perceptive of terms are pertinent for common understanding.

Water management Is defined as the planned development, distribution and use of water resources in accordance with predetermined objectives while respecting both the quantity and quality of the water resources. It is the specific control of all human interventions concerning surface and subterranean water. Every planning activity relating to water can be considered as water management in the broadest sense of the term (International commission on irrigation and drainage, ICID, 2000).

Traditional practices are the ones developed and followed by farmers and passed from fathers to children, whether they are best performers or not.

Farmer innovations are meant to be those that farmers have developed in the recent past in response to their needs and circumstances. These could be the results of their own experimentation at the site or adaptation of a technology they have seen somewhere else or of a technology or practice recommended by research or extension system. Such adaptations are usually made to fit to their circumstances.

Successful practices are meant to be the ones which farmers and communities are practicing successfully generating different types of benefits – social, economical, physical, agronomic, environmental, etc. Again such practices could include successful farmer innovations, traditional practices, adaptation of a research recommendation or of a practice practiced by farmers elsewhere.

Indigenous Knowledge is meant to be the knowledge of the farmers developed from the perception of their circumstances, environment, culture, social norms and values, etc. and experiences gained from their traditional practices.

This activity tried to document successful traditional practices and farmer innovations and adaptations related to agricultural water management and short comings in effective utilization of irrigation through semi-structured interview schedule. The schedule covered areas akin to irrigation methods and practices, agronomic practices, farming systems, improved operation and maintenance approaches, abstraction methods, conveyance and distribution, management of the water users, conflict resolution, input

supply, marketing of farm products, conservation of natural resources, equity and the likes.

The study was conducted in weredas of North Shewa zone of the Amhara region, where traditional Irrigation schemes were present and traditional innovation and practices were believed to have been widely in practice. The weredas were namely Ankober, Ansokiya Gemza, Basona Werana, Efratana Gidim, Kewet, Merhabete and Tarmaber representing the high, mid and lowland irrigation areas. Specific schemes were selected based on information from the bureau of agriculture of the respective weredas.

A semi-structured interview schedule, interviews with experts and field visits were used to document successful traditional farmers' practices and innovations in agricultural water management in the study schemes.

Results and Discussion

Irrigation water sources in North Shewa zone were mostly rivers and springs. Although few irrigation schemes were established recently, most traditional schemes in Kewet, Efratanagidim, Antsokiyagemza and Baso weredas were established long ago that farmers were observed to have difficulties remembering when they were operational. Some have lasted for more than three generations (more than 100 years). The present day traditional irrigation techniques therefore, had the touch of their fathers and forefathers.

Newly established schemes were built with the aid of NGOs and government interventions. For example, Lutheran church helped the construction of Melkajebdu irrigation scheme in Aliyu-amba, Ankober Wereda. The regional government has also constructed many schemes in North Shewa Zone. Among them are the schemes in Yellen and Wacho (Kewet wereda), Chacha irrigation scheme and others in Baso and other weredas. The traditional schemes were developed and maintained by the communities' participation. The new schemes which were developed employing modern abstraction and conveyance technologies were constructed by peoples' labor contribution and in some by employed labor. It was pointed out that there was little work under taken by the implementing agencies of the new schemes to educate and capacitate farmers to fully utilize irrigation. The reforms were mainly focused on

structural improvements that the practices in the so called 'modern' or preferably 'improved' schemes were similar.

In the visited traditional schemes the structures used in water abstraction were stone masonry stabilized by mud or soil and plant residues. Broad leaves were used to reduce seepage. Farmers indicated that river water abstraction took two forms depending whether the river is narrow and do not bring much eroded materials as well as bigger stones and/or the river is wide and come along with stones of varying sizes.

In the first case, a kind of check dam is constructed across the river to divert water in to the sides of the river. Some times the abstraction could have certain angle of inclination from the river sides. Although this form of abstraction requires regular maintenance especially in the beginning of irrigation seasons, the damage encountered is minimal due to the size of river flow and eroded material coming. Moreover, the water can easily over top the structure and flow without major damage. The check dams were usually constructed in places where the river course was narrow to reduce the time and material used for construction. Farmers also select the site considering whether or not the abstracted water could reach the command area they need to irrigate.

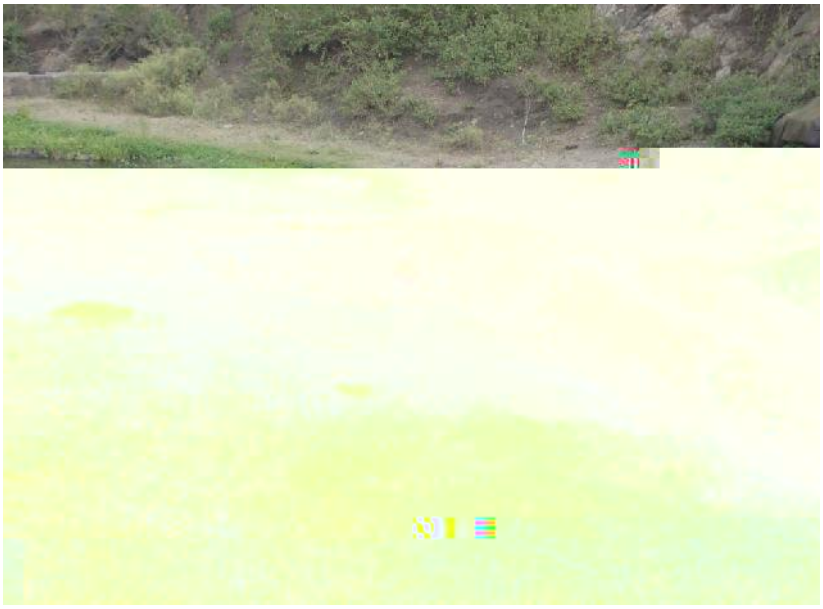

Figure 1. Checkdam type water abstraction on small streams (Majete)

In the case of wider rivers like Jemma, Jare and Jeweha, traditional abstraction is very difficult. Abstractions are constructed annually following the reduction of flow volumes. The place of diversion may also change positions annually. Since the rivers have huge discharges and come with a lot of eroded materials the water diversion structures are often washed away. In addition, every year the direction of flow is changed with in the river width. As a result, position of diversion could go upward or downward based on flow direction in the streams. Once the water is diverted it would be lead to the sides of the river and gradually rose to the ground level. In some places long canals must be constructed along the river sides to get the water on the field. This method was found to be very laboriously tiresome by the farmers but had to be done annually for survival.

Figure 2. Wide river abstraction techniques (Jemma)

Main canals were often times earthen. However, recently, cement lined canals were observed in the traditional schemes. The size of earthen main canals depends on the number of villages or irrigation schemes available. Traditionally, the size of secondary and tertiary canals was judged by the size of water it carry, that is, the number of furrows or 'Boy' it can feed. These measurements were also applied for water distribution, for instance, it was observed and pointed out by farmers that water is measured by 'boy wuha' in Majete. It is the same as saying water amount which satisfies optimum flow in a number of furrows. Although volumetric discharge

measurement were not observed, proportioning of water gives an entry point in introducing formal water measurement systems for economizing the use of the resource.

Farmers clean and maintain main canals and compact canal beds to reduce seepage. Canals face different obstacle in reaching the irrigated field. Especially in the high lands due to the topography, canals encounter steep slops, valleys and gullies. Farmers employ various methods to overcome the encountered obstacles. In case of steep slops, farmers either dig into the sides of the slope or build a stone masonry wall parallel to the slope on top of which water flows. Valleys, gullies or natural water ways are escaped using logs formed into canal like shape, metal sheet and in some cases concrete structures are used.

Figure 3. Irrigation canal crossing hill (a-Bakelo) and water way(b-Shewarobit)

Crop choices in the surveyed schemes vary according to the climate they were found. Onion, tef, pepper, sweet potato were crops widely under irrigation in the low and mid altitude areas while wheat, barley and garlic were in the highlands. Recently, cropping pattern changes were observed in traditionally irrigated areas. For example, long season sorghum planted late

April was replaced by irrigated onion and other vegetables in Mekoy, Antsokiya and irrigated wheat production has been almost band in Bakelo area in basso wereda. These, changes were mainly due to introduction of high valued crops like onion, driven by the market as in most of the lowland schemes, and disease and pest problems occurring in the dry season as in the highlands. In age old highland schemes however, since the practice of irrigation was in place for long and the crop choices were limited, farmers were using cropping patterns of their fathers.

Most of the farmers in the studied irrigated areas do not use released improved varieties; rather they kept using their own varieties by selecting the best plants. Moreover, commercial fertilizers were rarely applied to irrigated crops. This was mainly because of fertilizer prices and for fear of water shortages which might result in crop burns by fertilizers. In those who apply fertilizers to irrigated crops, the rate was less than the amount they incorporate to the rainy season crops. Although commercial fertilizer use was low in all schemes, the lowland schemes were batter than the highland and mid altitude schemes. Farm yard manure was used in Tach Sar Amba, Efrata wereda, for banana and papaya plantations.

Crop yields in all the surveyed schemes were reported lower in irrigation production than the rain fed production. This indicates the need to improve traditional schemes in terms of water productivity.

Table 1. Fertilizer usage in irrigated crops in some of visited schemes

Wereda	Scheme Name	Water Source	Production System	Crop	Fertilizer (rate)
Antsokiya Gemza	Lay Jare Mesno	Jare River	Rain Fed	Tef	**Urea** 2qt/Ha **DAP** 40-48 Kg/Ha
				Onion	Urea 2Qt/Ha
				Tomato	Urea 0-48 Kg/Ha
			Irrigated	Tef	-
				Onion	Urea 1Qt/Ha
				Tomato	Urea 0 -48 Kg/Ha
	Tach Jare Mesno	Jare River	Rain Fed	Teff	-
				Onion	Urea 2.4 Qt/Ha DAP 1 Qt/Ha
				Tomato	Urea 1Qt/Ha
			Irrigated	Teff	Urea nil DAP nil
				Onion	Urea 1.6 Qt/Ha DAP 1 Qt/Ha
				Tomato	Urea 0-1 Qt/Ha
Efratanagidm	Tachegnaw Sar Amba Mesno	Lisha Wuha Nazero River	Rain Fed	Onion	Urea 1 Qt/Ha DAP 50 Kg/Ha
				Corn	Urea 1 Qt/Ha DAP 1 Qt/Ha
				Banana	Farm Yard Manure
				Papaya	Farm Yard Manure
				Cabage	Urea 1 Qt/Ha DAP 48 Kg/ha
				Bit root	Urea 1 Qt/Ha DAP 48 Kg/ha
				Tomato	Urea 1 Qt/Ha
			Irrigated	Onion	Urea 2Qt/Ha DAP 1 Qt/Ha
				Corn	Urea 2Qt/Ha DAP 1 Qt/Ha
				Banana	Farm Yara nure
				Papaya	Farm Yara nure
				Cabage	Urea 2Qt/Ha DAP 1 Qt/Ha
				Bit root	Urea 2Qt/Ha DAP 1 Qt/Ha
				Tomato	Urea 2Qt/Ha

Wereda	Scheme Name	Water Source	Production System	Crop	Fertilizer (rate)
Ankober	Melka Jebdu Mesno	Melka Jebdu River	Rain Fed	-	-
			Irrigated	-	-
Tarmaber	Arid Amba Wonz	Arid Amba River	Rain Fed	-	-
			Irrigated	-	-
Tarmaber	Batug Mesno	Batug River	Rain Fed	Wheat	Urea 1Qt/Ha
				Teff	Urea 1Qt/Ha DAP 20 Kg/Ha
				Garlic	Urea 144 Kg/Ha
			Irrigated	-	-
Basona Worana	Gunagunet Mesno	Gunagunet River Dedot Spring	Rain Fed	Wheat	Urea 2Qt/Ha
			Irrigated	-	-

Flood irrigation was widely used method of water application. Furrow irrigation was seldom used for row cropped onion. According to the interviewed farmers these methods were selected due to lower labor requirement.

Farmers indicated that there were complementarities in irrigated and rain fed production systems. The first form was starting crops with the rain and finishing them by irrigation. This mode of production was practiced especially where farmlands were temporarily inundated by the summer rain especially in the highlands. Wheat, lentil, field pea fenugreek are mostly cropped in such a practice. The second form was to plant using irrigation and let it mature by the rain. Long maturing sorghum and corn were best examples of such production system in the lowlands.

Amount of water application depends on the farmer's judgment. It is said that the crop is well watered when the field is wet and there is accumulated water over the surface. Farmers had optimum watering frequencies when water is in surplus and in scares. But still the amount of application had unquantified variations from farm to farm and farmer to farmer.

As water is the most important resources in irrigation, its equitable use is very essential for a healthy scheme. As a result, farmers had different water management bodies. The most famous water administration body was the

"*Yewuha'abat*" or "Father of water". *Yewuha'abat* is an elected member of the community whom the farmers agree upon to be in charge of all water issue. On the bases of the scheme's area, he may have local administrators, especially if the scheme comprises of two or more villages. The *yewuha'abat* is recognized by the kebele's "*limate budin*". Water dispute and other water distribution issues are solved by the *yewuha'abat*. If things get out of the capacity of this body the kebele administration and elders will join to solve the problem. Other wise, the matter will be handed to the formal court. Most of the cases however, are taken care by the *Wuhaabat*.

There is also a similar institution to administer irrigation water in some areas (Jeweha area). This institution is known as "*Yewuha budin*". Elected members of the scheme are delegated to settle all water related issues for the equitable use of the resource by the community. The community formulates bylaws on scheme maintenance, annual fee, water use rules and charges upon defaulters. Although the charges vary from scheme to another, could reach 50 bir to water denial.

Water allocations were based on the size of the farm irrigated and the type of crops grown. Sensitive crops like vegetables were given frequent supplies. Priorities are also given to vegetables than cereal crops in case of water shortage. In addition, smaller farms were supplied in smaller fraction of the coming water. It is to be recalled that water is measured in 'boys', if the water coming in the secondary canal can supply certain boys and there are two farms being irrigated at the same time, the big sized farm will take the greater portion.

Farmers have established irrigation frequencies for their crops. Based on the availability of water these frequencies were adjusted. Cereals were generally irrigated less frequently than vegetables (Table 2). Generally speaking, farms were observed to be over irrigated once the supplies were on. However, frequencies seem to be in most cases low, for cereals in particular, implying longer irrigation intervals which might result in stress related yield losses. The frequencies happened to be consistent for a crop in similar agro-ecologies.

Table 2. Irrigation frequencies in some of visited schemes

Wereda	Kebele	Scheme Name	Crop	Frequency of Irrigation when water is	
				Sufficient	Scarce
Antsokiya Gemza	Agla Majete	Lay Jare Mesno	Onion	3-4 Daya	8 Days
			Tomato	2 Times/Season	2 Times/Season
			Tef	Once/Season	Once/Season
	Agla Mageta	Tach Jare Mesno	Teff	2times/Season	-
			Onion	6days	9days
			Tomato	15days	20days
	Mekoy 03	Gudaber	Onion	8 Days Interval	In 15 Days Interval
			Sweet Potato	Once In A Month	Once In The Season
			Chat	4 Days Interval	8 Days Interval
			Banana	8 Days Interval	In 15 Days Interval
			Tef	7 Days Interval	In 15 To 30 Days
			Fruit Trees	8 Days Interval	>20 Days Interval
			Papper	15 Days Interval	25 Days Interval
Efratanagi dm	Tach Sar Amba	Tachegnaw Sar Amba Mesno	Onion	4-5days	8days
			Corn	8days	10-15days
			Banana	8days	15days
			Papaya	8days	10days
Ankober	Aliyu Amba Zuria	Melka Jebdu Mesno	Onion	3 Days	5 Days
			Tomato	5 Days	10 Days
			Banana	7 Day	-
Tarmaber	Yitta	Arid Amba Wonz	Wheat	Once/Week	Once/Week-Month
			Fenugreek	Onece /season	-
	Koste Amba	Batug Mesno	Wheat	Twice/Season	Once/Season
			Garlic	3days	8days
			Onion	3days	8days
			Fenugreek	3times/Season	Once/Season
Basona Worana	Bakelo	Gunagunet Mesno	Wheat	Once/Season	
			Barley	Twice/Season	Once/Season
			Lenti	Once/Season	
			Beans	3times/Season	Once/Season
			Grlic	20days	30days
			Fenugreek	Twice/Season	Once/Season

Irrigation water was free of charge in most schemes studied. In some schemes where water users' cooperations exist, annual water fees were paid usually for expenditures in scheme maintenance. Farmers consider water as a free commodity and unanimously believe that it should not be traded. Moreover, farmers indicated that scarcity of water in the critical season makes it difficult to be traded since it is only given to those who need it critically.

Most of the irrigation schemes studied were accessible to local markets. Furthermore, they were located close to the main asphalt road. As a result it was possible to market their products in bigger markets earning better

values. For example, Majete and Shewarobit farmers provide their produces to as far as Mekele. However, despite the opportunities, individual farmers had market price problems. Due to the lack of organized associations, the currently benefiting actors were the middle men and some aware resourceful farmers. Although it was encouraging to see farmers going beyond their local markets and sell products in far markets as Mekele and Addis Ababa (as seen in Majete) the majority were resource poor and producing in small scales which limited them to be the beneficiaries of these opportunities.

Nevertheless, encouraging marketing innovation was seen in Majete. Taking lessons from the trading community, few farmers have stopped supplying local traders. Instead, they produce on their own farms and collect produces from the scheme by a better price than the traders offer, rent vehicles and sell it by taking it to bigger markets. This has created opportunities for the emergence of new community which we called trader-farmer. The presence of these farmers has improved the local prices and some times stabilize good prices for the local farmers.

In any of the schemes studied neither sign of health hazard brought about by irrigation, nor complaint by the users was come upon. This was mainly because the irrigation water is scarce. However, in Wacho kebele, Kewet wereda, it was observed that malaria was evidently important disease in relation to irrigation projects.

Conclusion and Recommendation

The study realized that farmers in North Shewa Zone had numerous traditional practices, innovation and indigenous knowledge in the management of agricultural water. As irrigated agriculture entail water abstraction, conveyance, application to the agricultural fields and administration of water for equitable utilization for successful production systems farmers own valuable knowledge through continues experimenting and experience on which modernization endeavors should be based and ready made techniques be transferred to similar locations.

Farmers also possess successful water administration techniques and organizations developed through years of experiences. They had formulated workable bylaws to equitably administer their water resources and avoid possible conflicts. It was possible to find strong social atmosphere on which irrigation and other agricultural modernization could depend on. Farmers were found to adequately utilize their agronomic practices in the irrigated

agriculture as well. Crop choices for specific locality depending on the available resources was practiced in every traditional scheme surveyed.

In the area of marketing agricultural produces however, limited awareness was found. Lack of organized approach to derive the best out of the production system had resulted in subsistent incomes which kept the development of the sector behind.

Areas in which improvement was keenly required include method of application and management of excess water, when and how much to irrigate and enterprise choice for profitable production system. The other important intervention part is the irrigated agriculture development. The development work requires huge investment which the farmers could not afford. Government and non-government organizations should play an important roll in developing the sector.

In the light of the study results it is recommended that;

1. Water abstraction and conveyance indigenous knowledge and techniques should be adopted to similar localities
2. Irrigated agriculture agronomic practices should be verified and adopted to similar localities
3. Water administration indigenous practices and knowledge should be transferred
4. Method of application and management of excess water should be addressed by the research system to improve the sector
5. When and how much to irrigate and enterprise choice for profitable production system should also be answered by research.
6. Marketing of agricultural produces should be supported by concerned government and nongovernmental agencies and efforts to organize producers should be continued by the same and the research system.

References

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