



Improved Livelihood Opportunities in Spate Irrigation

In this document several improvements in the management and utilization of spate irrigation systems are presented, based on good practices in different spate irrigation systems in the world.

1. Additional water management and water use practices

1.1 Redefining water distribution

Discuss how to fairly share the water within the command areas and in such a way that it is efficiently used (clear and transparent rules and arrangements) – looking at making (1) bed stabilizers at distribution points (2) permeant flow dividers (made of gabion) (3) bed raisers.



1.2 Smaller command areas

Consider smaller command areas to ensure larger chance of sufficient soil moisture with field even irrigated twice or more and more moisture stored in the soil profile. Make sure that rather a smaller area is irrigated adequate instead of a big area non-adequate.



1.3 Making field channels

Construct channels to guide spate water within the field and between fields.





1.4 Command area structures – controlled overflow structures

Controlled overflow structures help water getting from a fully filled field to the next in a controlled way – avoiding breaching of the side bunds and gulying and rutting from the water that rushes out of the field. There are several examples of such controlled overflow structures (orifice with a silting basin,).



1.5 Command area structures – field closure gates structures

When a large bunded field is filled with floodwater, it is a challenge to prevent the water rushing back. Field closure gates can be constructed to control the flow and avoid erosion in field to field systems.



1.6 Soil moisture conservation by soil mulching and deep ploughing structures

Mulching are loose coverings or sheets of materials placed on the surface of cultivated soil and retain moisture of the soil, help to control temperature fluctuations, suppress weeds, improve soil texture and protect plant roots from extreme temperatures. Biodegradable mulch like leaf mould, garden compost, wooden chippings and well-rotted manure are preferred. Particularly when cultivation starts long after the flooding season it is important to store moisture in the soil. Ploughing prior to irrigation to increase infiltration and after irrigation to conserve water. Plough about 0.15m deep to create a tilth.



1.7 Preparing land before flood season

By preparing and ploughing land before the floods come, more moisture will infiltrate in the soil during the floods.



1.8 Better field drainage

It is important that a field is drained properly and does not have standing water. Make simple structures to remove excess water from the field to reduce or eliminate water logging and return soils to their natural field capacity. Examples are subsurface tile drainage systems, surface disposal drains and two and three-tier drainage systems.



1.9 Road water harvesting

Harvesting run-off water from roads by using channels and culverts and spread this over land to provide additional water for crops/grasses/trees, collect it in storage structures (like roadside ponds, small depressions turned in oasis) or spread it over areas with high infiltration to boost shallow aquifer recharge.





1.10 Livestock watering

Harvest floodwater in ponds to be used as drinking and bathing water for livestock. Important to keep this separated from water that is used for domestic use.



1.11 Windmill

A Windmill that converts wind into energy to pump irrigation water.

2. New crop varieties/crop/cropping practices

2.1 Multiple cropping system



Combine two or more crops that complement each other's growth in one field. This reduces the risk of complete crop failure and also the use of fertilizer and pesticides. For example early and uniform maturing mung beans, and other pulses like moth, bakla beans, chickpeas and kidney beans fit well into this system.

2.2 New crops



The peanut is a heat and water resistant crop and is doing well under changing climate conditions on sandy soils. Sunflower is one of the major oilseeds of which two crops of (spring and autumn crops) can be grown in spare irrigated areas based on availability of spare flows.

2.3 Smart/improved varieties of main crops



Use of certified quality seeds of main crops like sorghum, lentils, chickpeas, guar and mong bean that have a wider adaptability with higher yield potential than others. The choice of variety depends on many parameters. Examples of improved sorghum varieties in Pakistan are Johar, DS-2003, YSS-98, DS97, Ghiza-3, Pak SS-2 and DS-75. Examples of lentil varieties suitable for the selected spare irrigation areas are: Malka Masoor, Masoor 85, Masoor 93 and Shiraz 96. Examples of improved guar varieties are: BR-99 and BR-2017.

2.4 Harvesting desert truffle mushrooms

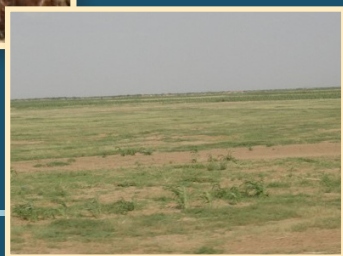


There are 21 varieties of wild mushrooms edible in Pakistan and the desert mushroom is one of it. This one grows underground and has no stalk or cap, is white of colour and irregular shaped. The size varies from 2-6 centimetres and in spate irrigation areas it enters into symbiotic relations with sorghum. Prices for desert truffles can be higher than RS. 20,000 per kg in Pakistan.

2.5 Fodder grasses mushrooms



Growing fodder extensively by spreading flood water can sustain livelihoods in difficult dryland conditions. Seeding rangeland grasses is shown to increase the productive potential in semi-arid and arid environments include Horse Tail, Fox Tail, Masaai Love Grass and Wilde Reye grass.



2.6 Medicinal plants

Growing of medicinal plants that cure and prevent diseases and can be sold at good prices. For example tuma, a melon-like fruit that is purely medicinal with an extremely bitter taste marketed in herbal shops throughout the country. Another medicinal plant is isabgol which usually grows out of seeds from the previous year. The husk of the plant is very useful for the treatment of chronic bacillary dysentery and chronic constipation and is sold at good prices.



2.7 Oilseed crops

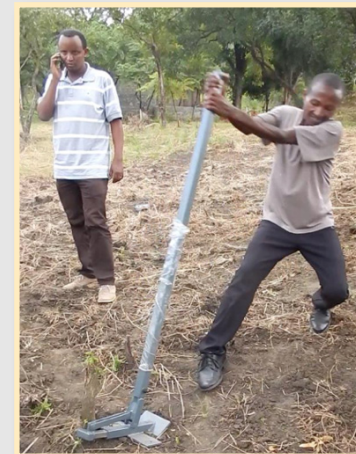


The water requirement of oilseeds is less than wheat and perform better even in dry spells. There are a number of oilseeds that proven to be promising for spate irrigated areas

including rapeseed, mustard, canola, sunflower, safflower, sesame, castor and linseed. These are sometimes grown as a mix crop with wheat and fodders.

2.8 Tree puller

The tree puller is used to uproot small trees or old trees and has a claw, fulcrum and an arm as lever with which trees with a stem diameter up to 5cm and with relatively shallow rooting systems can be uprooted.



2.9 Scythe

The scythe is used to harvest dry-stem crops and grasses. It reduces long working hours compared to a sickle since it weeds four times faster than a sickle. It is used by twisting the upper body and then cutting up to 30 cm of plants that stand to the right in one sway. The blade should be strong and the handle long enough for the thick varieties of sorghum for instance.



2.10 Single axle tractor



The single axle tractor is powered by a fuel-efficient water-cooled diesel engine and can be fitted with metal paddle wheels for working in wet conditions to prevent slipping. The machine is able to undertake multitask agricultural operations like ploughing, rototilling and towing trailer. In stationary mode as a power source it can be used for water pumping, grain threshing, flour milling, fodder cutting and food oil pressing.

3. Value chain practice such as improved storage

3.1 Improving local grain storage



Horticultural crops such as fruits and vegetable are highly perishable in nature and therefore good post-harvest techniques are needed to reduce physiological processes of senescence and maturation to minimize

the risk of microbial growth and contamination. The storage life of fruits and vegetables can be extended greatly by removing the field heat and cooling as soon as possible after

harvesting. Several improved local grain storage options are: baskets, underground storage, polyethylene bags/hermetic storage, jute bags, improved mud storages, brick and iron silos.

3.3 Oil press



The oil press is an electrical machine that extracts oil from different kind of seeds such as rapeseed, mustard and sesame. It processes the

seeds to produce a high value oil and reduces potential losses from rodents, birds and molds attacking seeds. The raw seeds are squeezed under high pressure, friction causes it to heat up and the oil seeps through small openings that do not allow seed fiber to pass.

3.4 Charcoal cooler



since charcoal is readily available and can hold water. A wooden frame supports the walls and roof. The use of wooden pallets on the floor is advisable to keep the produce off ground reducing the likelihood of infection with soil borne diseases and moulds.

3.2 Fodder chopper

The fodderc
hopper is a hand
or electricity
driven machine



that can be used to chop fodder. It saves time and energy compared to manual cutting of fodder and is easy to maintain and operate. It can be adjusted to chop dry and fresh fodder and can be produced locally.

3.5 Flour mill

A flour mill is a mechanical grinding machine used to make flour by rotating two stones. It has a bigger capacity and conserves more time and energy for operating as compared to a hand flour mill. It can be locally produced.



3.6 Marketing for organic consumption

A majority of the crops grown in the project area are free from chemicals and are grown as organic crops. This produce is recognised for its good quality and better taste but due to remoteness of the spate areas, the market for quality organic produce is local. This organic produce can be sold either double or more than double of the price in international markets. Connection of organic consumers with traders, retailers, wholesalers and processors is needed to form the value chain of this organic produce. These crops need to be marketed so they grab the attention of these stakeholders.



3.7 Food preservation techniques

Food preservation is a method to maintain food at a desired level of properties or nature for the maximum benefits. There are traditional food preservation methods carried by chemical, biological or physical means. The following traditional and low-cost preservation methods are suggested: drying, fermenting, pickling, and smoking.

3.8 Controlling rodents

Biological control using the indigenous knowledge of the local people could have far reaching results in rodent control while minimizing the side effects of polluting the environment that comes from using rat poison.



4. Processing or grading; livestock and poultry practice

4.1 Electric milk churner with solar panel

The electric milk churner is an electrical churner used to extract butter directly from milk which takes about 15 minutes. It saves time and energy compared to the manual way of extracting butter by hand. The churner can be produced locally.



4.2 Poultry

Promoting the growth of poultry by vaccinating, using hatching pans (hazals), small hen houses, and candling eggs to check their fertility.



4.3 Livestock: improved disease treatmentsolar panel

Reducing animal mortality and production losses and improve the position of women in spate irrigated areas by teaching them on how to apply improved disease treatment. The main livestock diseases are ecto- and endo- parasites, trypanosomiasis, mange, sheep pox and pasteurellosis. The main control measure is annual vaccination or traditional medicine using herbs.



4.4 Improving rangeland with intensive controlled grazing



Holistic planned grazing is practicing intensive grazing for short periods in small areas which will improve the regeneration of all grasses and the capacity of the soil to absorb occasional rainfall. Planned grazing by bunched animals can restore grasslands and add to their productivity as well as biodiversity and capacity to sequester carbon.

4.5 Processing and marketing livestock products

Through increased consumption of livestock products and increased income through sale of animals and dairy products, food security can increase. Additional rural income can be provided if markets are developed for underutilized resources such as skins and wool and expanded production of by-products such as cheese.



4.6 Breeding and exchange programs for goats



Breeds like Zhe (good meat and adapts to lowlands), ware (adapts to lowlands), Tzaadit (high milk yielder 2-3 liters/day) are common in Eritrean spate areas. Breeds like Somali (adapts to dry areas, high milk yielder) and Adal are common in Ethiopian spate areas. Barbari (high flock) is common in Pakistan. The Sudanese desert goat is common in spate areas in Sudan. Taiz (famous Taiz cheese), Mawr (good meat) and Surdud (high weight, good meat) are common in spate areas in Yemen. Breeding and exchanging these breeds between spate areas can increase the production of meat and milk.

4.7 Breeding and exchange programs for sheep

Breeds like Bahria (high milk yielder 3 liters/day), Tsaeda (high milk production and low feeder), Barka (good meat and milk) and Kaieh (good meat) are common in Eritrean spate areas. Breeds like Afar (good



adaptation), Bonga (growth rate, meat quality fattening, twinning and temperament), Horro (growth potential) and Menz (productive under low input) are common in Ethiopian spate areas. Balochi (good wool) is common in Pakistan. Sudan desert sheep (good adaptation and long walking distance), Hamary, Nuba and Banya Garar (good meat) are common in spate areas in Sudan. Dhamari (good weight) and Taiz red (limited feed supply) are common in spate areas in Yemen. Breeding and exchanging these breeds between spate areas can increase the production of meat and milk.

4.8 Breeding and exchange programs for bullocks

Breeds like Arado (good adaptation), Begait (good meat and milk production) and Bahri (good meat and milk production) are common in Eritrean spate areas. Breeds like Boran (milk production, high heat and disease tolerance), Sanga and Zenga are common in Ethiopian spate areas. Bhagnari (good for heavy draught work), Lohani (light work in hilly areas), Dajal (good meat), Rojhan (draught work, low fodder) and Red Sindhi (high milk yield) are common in Pakistan. Gash (good milk and meat), Arashie (high milk yield up to 10 liters/day), Butuna (high fat in milk) and Bagarra (good meat) are common in spate areas in Sudan. The Yemeni shorthorn Zebu (high milk yield) is common in spate areas in Yemen. Breeding and exchanging these breeds between spate areas can increase the production of meat and milk.



5. Livelihood practices such as agroforestry



5.1 Agroforestry

Agriculture using trees has several advantages like increasing soil fertility (using nutrient fixing trees like *Faidherba albida*, windbreak trees like *Azadirachta indica* and erosion control trees like *acacia Senegal* and *anacardium occidentale*) and increasing water availability (conservation agriculture and shade trees like *Andansonia digitate*, *Azadirachta indica*, *Magnifera indica* and *Parkia biglobosa*). Different type of systems can be implemented: alley cropping, multistrata, protective, silvo-pasture and woodlots. In Yemen small *acacia ehrenbergia* plantation serve as input for charcoal production. In Pakistan block plantations of *acacia nilotica* can do well.



5.2 Multipurpose trees

The use of multipurpose trees is the backbone of spate agricultural farming systems and are used for a.o. shading, timber, fodder, fencing, fire wood, edible fruits, sand dune stabilization, honey, medicinal, charcoal, handicrafts (like from the Mazri plant), spate diversion, bird nesting and root-use. Most common multipurpose trees are Selam, Sedr, Ber, Arack, Jaal, Haleg, Date Palm, Dome, Athel, Daber, Jand, Karita, Kikar and Mesquite. The outputs of these trees provide income on top of the income of farming and can serve as

a reserve fund. In case of drought and other harsh climate conditions, their crops might die but the trees will survive. On top of that they are symbols of religion and praised in poetry and literature.



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The use of multipurpose shrubs is the backbone of spate agricultural farming systems and are used for a.o. shading, timber, fodder, fencing, fire wood, edible fruits, sand dune stabilization, honey, medicinal, charcoal, handicrafts, spate diversion, bird nesting and root-use. Most common multipurpose shrubs are Paneer, Boi, Lana, Phag, Sinwaar, Ak, Plantain, Wanza, Sisal, Poinsettia, Mangrove and Mutundu. The outputs of these shrubs provide income on top of the income of farming and can serve as a reserve fund. In case of drought and other harsh climate conditions, their crops might die but the shrubs will survive. On top of that they are symbols of religion and praised in poetry and literature.

5.4 Wild crops



Several minor crops grow wild and have valuable benefits. The seeds are left in the soil and germinate usually after the area has been irrigated by the spate flow. Sanwak, cheena and smookha are examples. Bread and porridge are made with their seeds, their leaves and stems are used as roofing material and the whole plant serves as animal feed, especially in times of drought. Isagbol is a wild medicinal plant.

5.5 Honey production

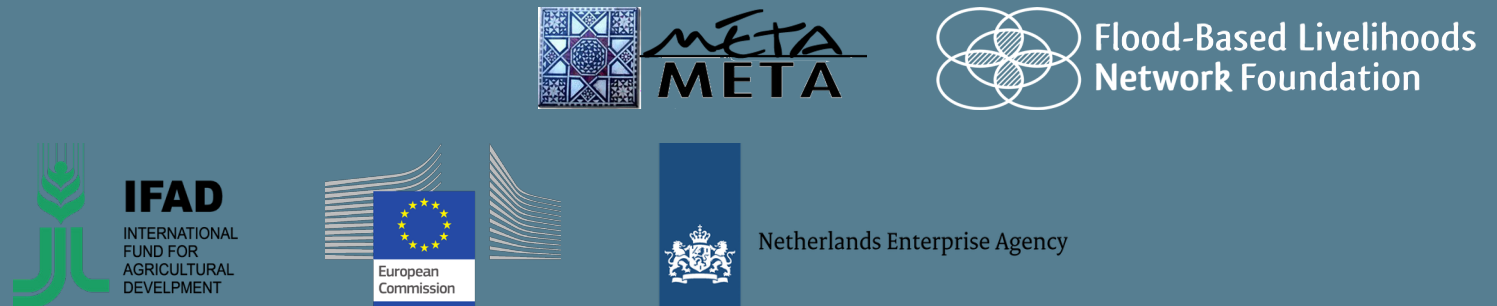


High quality honey can give a high profit on the market. There are several multipurpose trees and shrubs like Selam, Sedr, Ber, Date palm, Karita, Mesquite, Wanza and Poinsettia that can be used for honey production.

Checklist

1	Additional water management and water use practices		
	1.1	Redefining water distribution	
	1.2	Smaller command areas	
	1.3	Making field channels	
	1.4	Command area structures – controlled overflow structures	
	1.5	Command area structures – field closure gates	
	1.6	Soil moisture conservation by soil mulching and deep ploughing	
	1.7	Preparing land before flood season	
	1.8	Better field drainage	
	1.9	Road water harvesting	
	1.10	Livestock watering	
	1.11	Windmill	
2	New crop varieties/crop/cropping practices		
	2.1	Multiple cropping system	
	2.2	Smart/improved varieties of main crops	
	2.3	New crops	
	2.4	Harvesting desert truffle mushrooms	
	2.5	Fodder grasses	
	2.6	Medicinal plants	
	2.7	Oilseed crops	
	2.8	Scythe	
	2.9	Tree puller	
	2.10	Single axle tractor	

3	Value chain practice such as improved storage		
	3.1	Improving local grain storage	
	3.2	Fodder chopper	
	3.3	Oil press	
	3.4	Flour mill	
	3.5	Charcoal cooler	
	3.6	Marketing for organic consumption	
	3.7	Food preservation techniques	
	3.8	Controlling rodents	
4	Processing or grading; livestock and poultry practice		
	4.1	Electric milk churner with solar panels	
	4.2	Poultry: Vaccination, hatching pans, hen houses, candling	
	4.3	Livestock: improved disease treatment	
	4.4	Improving rangeland with intensive controlled grazing	
	4.5	Processing and marketing livestock products	
	4.6	Breeding and exchange programs for goats	
	4.7	Breeding and exchange programs for sheep	
	4.8	Breeding and exchange programs for bullocks	
5	Livelihood practices such as agroforestry		
	5.1	Agroforestry	
	5.2	Multipurpose trees	
	5.3	Multipurpose shrubs	
	5.4	Wild crops	
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