Laying of polyethylene film (Eshchanov R.A.)

Lining the bottom of the channel with polyethylene film (Uzbekistan)

Waterproofing of the channel with polyethylene film /lining the bottom of the channel with polyethylene film

DESCRIPTION

Covering the bottom of the channel and slopes with polyethylene film reduces water infiltration losses during transportation from the source to the field and increases the water use efficiency from 0.50 to 0.89 points

There are about 4.3 million hectares of irrigated lands that are served by irrigation canals with a length of over 180 thousand km in Uzbekistan.
Large trunk and inter-farm channels have concrete insulation, intra-farm canals are mostly laid in an earthen bed. Water losses due to infiltration reach 50-60% in the ground channels, which is a huge amount, given the scale of irrigation systems. Channel infiltration losses are the main source of groundwater supply and the reason for their high level. As a result of evaporation, salts from groundwater rise to the surface and accumulate in the topsoil. Fields located in the rear of the channels receive insufficient water volume due to high losses. Consequently crop yields are reduced, wind erosion processes are intensifying. The fact that half of the water taken from rivers is lost from canals requires decisive and urgent action. Sheathing/ lining the channels with concrete is a very expensive solution. In the 80s of the last century, various measures to reduce infiltration were used: compaction, gleying, colmatation with chemicals, colmatization with clay particles and bentonite, bitumen, etc. Lining the bottom of the channel with plastic film could be an alternative. The only opponent of polyethylene is ultraviolet rays, and this requires constant monitoring and sprinkling of film on the sides of the channel. Otherwise, the duration of such waterproofing is almost unlimited. The Technology was tested by representatives of Urgench State University with the support of the GEF SGP on the Navruz-Yap channel in the Yangyaryk district of the Khorezm region (2009-2012). The 2.6 km long channel provided 400 hectares of irrigated land with water and provided water to more than 2500 local people. Before taking measuresa to reduce water infiltration losses, the channel efficiency changed seasonally from 0.43 to 0.52 (0.49 on average). With a channel capacity of 1.5-2 m3 / s, a lack of irrigation water was constantly observed due to infiltration. In the Khorezm region, channels without infiltration coverage, such as Navruz-Yap, occupy more than 98% of the territory.

The Technology includes:
1.Cleaning works with the use of an excavator
2.Construction of small hydraulic structures to ensure gravity flow of water in the channel
3.Manual preparation of slopes and the bottom of the channel to ensure gravity flow of water.
4.Creation of a 10-15 cm sand layer for laying a plastic film
5.Laying a plastic film 100 microns thick.
6. Filling the bottom and the edges of the channel over the film with a 10-15 cm sand layer to avoid film damage.
7.Backfilling the bottom of the channel with soil, 1 m thick, and the edges of the channel 0.5-0.6 m thick

The total cost of waterproofing 1 km of the channel is 15324 USD.
Savings were achieved through the delivery of material (9575 USD). Energy savings (no need for pumps) are 3207 USD (2013).
An additional cotton crop and, accordingly, additional income were obtained due to the extra irrigated area (water can reach the end of the canal) and due to an increase in productivity (decrease in the groundwater level in nearby fields). The total Technology benefit is 13,252 USD (calculations per 1 km of the channel, 2013). Estimated payback is 1-2 years. However, not every farmer can invest 15324 USD per 1 km of canal. Nevertheless, there are already farmers who intend to apply this technology. They hope that this will provide sufficient watering, especially in conditions of low water, which has become more frequent in recent years.

LOCATION

Location: Yangiarik district / Khorezm region, Uzbekistan

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 60.64243, 41.41533

Spread of the Technology: evenly spread over an area (approx. 10-100 km2)

In a permanently protected area?:

Date of implementation: 2009; less than 10 years ago (recently)

Type of introduction
- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☑ during experiments/ research
- ☑ through projects/ external interventions

Construction of small hydraulic structures in the head of the channel (Eshchanov R.A.)

Channel cleaning (Eshchanov R.A.)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [ ] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [x] reduce risk of disasters
- [x] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [ ] create beneficial social impact
- [x] reduction of unproductive water losses from channels

Land use

Waterways, waterbodies, wetlands - other (specify): irrigation channel
Main products/ services: Reduced water filtration in the channel

Water supply

- [ ] rainfed
- [ ] mixed rainfed-irrigated
- [x] full irrigation

Purpose related to land degradation

- [ ] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

chemical soil deterioration - Cs: salinization/ alkalinization

physical soil deterioration - Pw: waterlogging

biological degradation - Bl: loss of soil life

SLM group

- irrigation management (incl. water supply, drainage)
- energy efficiency technologies

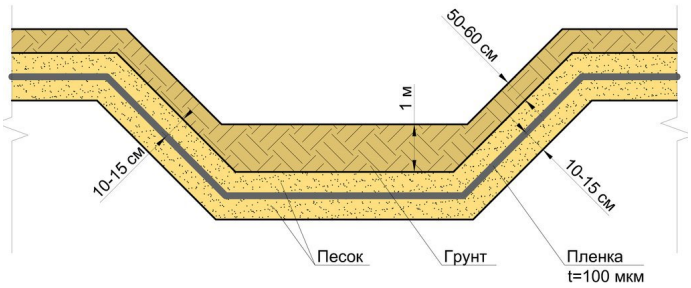
SLM measures

structural measures - S7: Water harvesting/ supply/ irrigation equipment

TECHNICAL DRAWING

Technical specifications

To ensure the water gravity movement to irrigated fields, the following measures are taken: cleaning the channel, filling the soil to create a channel slope angle.
After that, the bottom and slopes are filled with 10-15 cm sand layer, on which a polyethylene film with a thickness of 100 microns is laid. The next step is filling the film, first 10-15-cm layer of sand to avoid damage to the film, and then the filling of the channel bottom with soil, a layer of 1 m, and the channel slopes with a layer of 0.5-0.6 m.
Technical drawing from left to right: 10-15 cm - Sand - Ground - Polyethylene film (100 microns) - 10-15 cm - 50-60 cm



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ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 km**)
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = 2100.0
- Average wage cost of hired labour per day: about 10 USD

Most important factors affecting the costs

There are no special costs for maintaining the technology.

Establishment activities

1. Cleaning works with the use of an excavator (Timing/ frequency: During Autumn-Winter period)
2. Manual preparation of slopes and channel bottom (Timing/ frequency: During Autumn-Winter period)
3. Irrigation (counter irrigation) (Timing/ frequency: During Autumn-Winter period)
4. Creating a 10-15 cm sand layer for laying the film (Timing/ frequency: During Autumn-Winter period)
5. Laying of polyethylene film (Timing/ frequency: During Autumn-Winter period)
6. Filling the bottom and the edges of the channel over the film with a layer of sand and soil (Timing/ frequency: During Autumn-Winter period)

Establishment inputs and costs (per 1 km)

Specify input	Unit	Quantity	Costs per Unit (USD)	Total costs per input (USD)	% of costs borne by land users
Labour					
The cost of manual labor and mechanization	USD/km2	1.0	14279.0	14279.0	
Construction material					
Polyethylene film for channel insulation	USD/km2	1.0	1045.0	1045.0	
Total costs for establishment of the Technology				**15'324.0**	
Total costs for establishment of the Technology in USD				*7.3*	

Maintenance activities

1. Control and sprinkling the film with the soil on the sides of the channel (Timing/ frequency: permanently)
2. Cleaning the channel from silting (Timing/ frequency: In the early spring before the start of the irrigation period)

Maintenance inputs and costs (per 1 km)

Specify input	Unit	Quantity	Costs per Unit (USD)	Total costs per input (USD)	% of costs borne by land users
Labour					
sprinkling the film with the soil on the sides of the channel		1.0	100.0	100.0	
Equipment					
Cleaning the channel from silting					
Total costs for maintenance of the Technology				**100.0**	
Total costs for maintenance of the Technology in USD				*0.05*	

NATURAL ENVIRONMENT

Average annual rainfall

- [x] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone

- [ ] humid
- [ ] sub-humid
- [ ] semi-arid
- [x] arid

Specifications on climate

90% of the precipitation falls between October and May
Name of the meteorological station: Urgench
The duration of the growing season is 70 days

Slope
- [x] flat (0-2%)
- [ ] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms
- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [ ] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [x] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in
- [ ] convex situations
- [ ] concave situations
- [ ] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [x] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [x] < 5 m
- [ ] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [x] good
- [ ] medium
- [ ] poor/ none

Water quality (untreated)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to:

Is salinity a problem?
- [x] Yes
- [ ] No

Occurrence of flooding
- [ ] Yes
- [x] No

Species diversity
- [ ] high
- [x] medium
- [ ] low

Habitat diversity
- [ ] high
- [x] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [ ] 10-50% of all income
- [x] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [ ] manual work
- [ ] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [ ] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [x] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [ ] small-scale
- [x] medium-scale
- [ ] large-scale

Land ownership
- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [x] leased
- [ ] individual

Water use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual
- [x] through Water Users Associations and irrigation systems management

Access to services and infrastructure

health	poor ✓	good
education	poor ✓	good
technical assistance	poor ✓	good
employment (e.g. off-farm)	poor ✓	good
markets	poor ✓	good
energy	poor ✓	good
roads and transport	poor ✓	good
drinking water and sanitation	poor ✓	good
financial services	poor ✓	good

IMPACTS

Socio-economic impacts

irrigation water availability	decreased ✓	increased

demand for irrigation water — increased ... decreased
farm income — decreased ... increased

Socio-cultural impacts

Ecological impacts
groundwater table/ aquifer — lowered ... recharge
drought impacts — increased ... decreased
emission of carbon and greenhouse gases — increased ... decreased

Off-site impacts
impact of greenhouse gases — increased ... reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs
Short-term returns — very negative ... very positive
Long-term returns — very negative ... very positive

Benefits compared with maintenance costs
Short-term returns — very negative ... very positive
Long-term returns — very negative ... very positive

Technology pays off economically. Water conservation, energy savings, income from additional yields provide total benefits of 13,252 USD per 1 km of the channel. The estimated payback is 1-2 years.

CLIMATE CHANGE

Gradual climate change
seasonal rainfall decrease — not well at all ... very well — Season: spring
seasonal rainfall decrease — not well at all ... very well — Season: summer

Climate-related extremes (disasters)
drought — not well at all ... very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology
- [x] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?
- [x] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?
- [ ] Yes
- [x] No

To which changing conditions?
- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view
- Water loss from the channel is reduced, and crop productivity is increased
- Groundwater level decreases and waterlogging is reduced

Strengths: compiler's or other key resource person's view
- Unproductive losses are reduced, the risk of waterlogging and secondary salinization is reduced
- The water availability and crop yields are Increased

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome
- High cost Government subsidy

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome
- High initial costs of inputs on Technology implementation Lending, Association of water users

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_4010/

Linked SLM data
n.a.

Documentation was faciliated by

Institution
- n.a.

Project
- Decision Support for Mainstreaming and Scaling out Sustainable Land Management (GEF-FAO / DS-SLM)

Links to relevant information which is available online
- Channel bottom isolation technology for water and energy conservation. SGP GEF: sgp.uz/news/622; uz.denemetr.com/docs/676/index-33405-1.htme