1

ANNEX

Fieldwork materials

Each member of the team should be well equipped with walking boots, waterproofs, a drinking water bottle and notebooks. The team should have a mobile phone or radio equipment and emergency numbers / frequencies. A tentative list of equipment for the field team is provided below. The equipment should be ordered well ahead of the start of the field assessment as international ordering can take more than one month.

Tools / equipment for each field team

Tools / Equipment	Number	Additional Comments
Compass (360°)	1	• High precision, in degrees • Waterproof and resistant
GPS receiver (Geographic Positioning System) and extra batteries	1	• Possibility to calculate average point • Optional antenna
Digital camera+ Spare memory card + Extra batteries + charger	1	For recording land degradation type and severity and SWC measures
Topographic maps and field maps, including national LADA LUS map	As available	If possible 1:50,000 scale of each LAA
Aerial photographs and/or satellite imagery	if possible	Enabling historic analysis of land use change);
Abney level or Altimeter- for measuring land slope and tree height	1	Haga altimeter, Suunto graduated in degrees and %
Measuring Tape or rope or chain -30-50m	1	Metric, marked at every 1-5 meters (if possible self-rolling)
Quadrats - for vegetation sampling • 1m x 1m • 1m x 1m with 10 divisions	2	made locally using metal /bamboo rods and wire
Flora and fauna species list / identification key	As necessary	On forestry, pasture, range, weeds, pests and others are relevant topics
Soil auger	1	
Spade /Hoe	1	
1 Plastic Basin + 1 hard board insert + 4 Plastic sheets	1	For soil measurements on structure, texture, porosity, type, colour
Soil pH Test Kit and plastic plates (10cm diam;2cm deep)		can also be used for water
Plastic bags		For collection of samples (soil/plants/ leaves)
Water infiltration cylinders (100mm long x 100mm diameter)	2	locally fabricated from metal /plastic tubes
Machete	1	and file for sharpening
Penknife	1	
Rucksacks and heavy duty plastic bags	2	To protect measurement instruments and forms
Ranging poles	1-2	- straight; about 2m long, 3-4 cm thick can be made locally e.g. bamboo
Flipchart and paper and tape	1	For community/group discussions, PRA maps/ diagrams (several flipchart sheets can be taped to make a large sheet)

Tools / equipment for each field team *(continued)*

Tools / Equipment	Number	Additional Comments
Clipboards for reporting forms	3	To take notes (with plastic bag to protect from rain)
Field recording forms	As necessary	
LADA-L Field manual		
Notebooks, pens, pencils, marker pens		
First aid kit	1	

Optional tools / equipment (to be decided in country)		
For measuring soil labile C: • Hand held Colorimeter • conical centrifuge tubes (50 ml) • holding rack • plastic syringe (50 ml) • graduated bulb pipettes 5ml • 5 cm^3 soil scoop • $KMnO_4$ (crystalline) • $CaCl_2$ (crystalline)	1 20 1 1 several 1 as necessary	• single (550 nm wavelength) • graduated • • • disposable to make 33 mM $KMnO_4$ solution to make CaCl solution
For measuring soil and water salinity • Electrical conductivity meter		
For measuring vegetation size/quality • Diameter tapes for tree diameter • Callipers - shrub stem diameter	1	 • Metric, Auto rewind • Metric,
For measuring water quality • Portable water analyzer (EA513-162)	1	To measure pH, dissolved oxygen, conductivity and temperature
Plant press and newspaper	Optional	For safeguard of plant parts

ANNEX 2

Sustainable Land Management Technologies

Common types of SLM technologies / management practices are described below.

SLM Technology	Description
Integrated Soil Fertility Management (mainly agronomic measures)	Benefits from positive interaction and complementarities of the combined use of organic and inorganic plant nutrients in crop production. • **Organic matter management** such as manuring, composting, mulching and nutrient management using local plants such as Tithonia - these practices enhance soil structure, rainwater infiltration and moisture retention, also replenishing nutrients; • **Fertilizer use** to overcome nutrient deficiencies. Precision farming should be used to optimize fertilizer use (as well as other inputs seed, water etc).
Conservation agriculture (CA) (mainly agronomic measures)	CA is a system characterised by 3 basic principles: • minimum soil disturbance (i.e. zero or minimum tillage and direct planting - to prevent damage to soil structure by repetitive tillage); • permanent soil cover (to the extent possible) to improve soil structure, infiltration, and reduce erosion by water and wind); • crop rotation.to optimise use of the soil. This is suitable for large- as well as small-scale farming.
Organic agriculture	A holistic production system which promotes and enhances agro-ecosystem health (biodiversity, biological cycles, soil biological activity). It emphasises the use of management practices in preference to the use of off-farm inputs. Agronomic, biological and mechanical methods, are used where possible, as opposed to using synthetic materials, to maintain functions within the system. Many of the techniques used (e.g. inter-cropping, crop rotation, double-digging, mulching, crop- livestock integration) are practised under other agricultural systems. What makes organic agriculture unique, as regulated under various laws and certification programmes, is that: (1) almost all synthetic inputs are prohibited (i.e. those harmful to human and environmental health) and (2) `soil building' crop rotations are mandated (i.e. designed to steadily improve soil tilth and fertility while reducing nitrate leaching, weed, pest and disease problems).

SLM Technology	Description
Cross-slope barriers on sloping lands (vegetative or structural, often combined with vegetative and agronomic measures)	These include a range of measures on sloping lands for reducing run-off velocity and soil erosion They may be in the form of: • **earth or soil bunds, stone lines**; • **vegetative strips** often grasses or trees that may lead to the formation of bunds and terraces due to the downslope movement of soil during cultivation; • **terraces** vary in form (from forward-sloping terraces to level or backward-sloping bench terraces) with or without drainage systems. Irrigated terraces (e.g. for paddy rice) are a special case in terms of water management and terrace design.
Rotational cropping systems	Sustainable rotational systems are characterized by the rotation of different land use and management intensity such as a few years of intensive crop production followed by a period of low intensity use allowing natural regrowth (fallow) or replanting of grasses, legumes, trees etc. followed by intensive use and clearing of the vegetation. • **Shifting cultivation** is an agricultural system in which plots of land are cultivated temporarily then abandoned. This system often involves clearing of a piece of land followed by several years of wood harvesting or farming until the soil loses fertility. Once the land becomes inadequate for crop production, it is left to be reclaimed by natural vegetation, or sometimes converted to a different long term cyclical farming practice. • **Slash and burn** refers to the cutting and burning of forests or woodlands to create fields for agriculture or pasture for livestock, or for a variety of other purposes Natural regeneration of soil fertility is an important aspect of the system.
Integrated Crop-Livestock Management	These systems optimise the uses of crop and livestock resources through interaction and the promotion of synergies. For example, wastes from livestock replenish soil nutrients, secondary products of crops (i.e. straw and residues) are used for livestock feed and grass leys and fodder crops may be included in the system Specific practices include: • night corralling; • rotations and manuring and composting; • grazing and fodder production.

SLM Technology	Description
Sustainable grazing land management (management practices with associated vegetative and agronomic measures)	Improved management of grazing land involves changing the control and regulation of grazing pressure. It is associated with an initial reduction of the grazing intensity. Examples include; • fencing, followed either by rotational grazing; • cut-and-carry of fodder, vegetation improvement and management change.
Pastoralism and rangeland management	Sustainable grazing on natural or semi-natural grassland, grassland with trees and / or open woodlands. Animal owners may have a permanent residence while livestock is moved to distant grazing areas, according to the availability of resources. Practices include for example; • rotational grazing; • dry season fodder reserves; • improved well / borehole distribution.
Agroforestry (mainly vegetative, combined with agronomic)	These are land use systems where woody perennials are grown in association with agricultural crops or pastures for livestock. These catalyse a variety of benefits and improved services, including better use of soil and water resources, multiple fuel, fodder and food products, habitats for associated species. There are a wide range of systems, including: • shelterbelts; • trees to provide shade for tea, coffee etc.; • multi-storey cropping (e.g. home gardens).
Sustainable Planted Forest Management	Planted forests can be either commercial or for environmental / protective use or for rehabilitation of degraded areas. Sustainability of new planted forests depends on what they replace (i.e.. this should avoid loss of natural forest). This includes: • afforestation (e.g. for watershed protection; tree belts for halting desertification); • replanting of forests; • improved forest (e.g. species composition, health); • protection against fires; • improved management of forest use and felling of trees.
Sustainable Forest Management • in drylands • in rainforests	This encompasses administrative, legal, technical, economic, social and environmental aspects of the conservation and use of forests. Examples include: • assisted natural regeneration of degraded land; • indigenous management of specific woodlands / species; • forest bee keeping; • community forest management.

SLM Technology	Description
Water harvesting	Water harvesting is the collection and concentration of rainfall runoff for crop production or for improving the performance of grass and trees in dry areas where moisture deficit is the primary limiting factor. It may also be used for livestock and domestic uses. Examples include; • Tassa /Zai planting pits; • small earth dams; • floodwater farming.
Surface and ground water management	All measures that lead to an improved regulation of the water cycle, reducing flood flows, improving water infiltration in the soil and the recharge of the groundwater table or in case of salinity to lower the ground water table and improve water availability and quantity. This includes: • improved irrigation techniques for water use efficiency (e.g. drip irrigation); • salinity regulation; • control of storm water and runoff from sealed surfaces (i.e measures designed to deal with extreme events).
Smallholder Irrigation Management	Aims to achieve higher water use efficiency through more efficient water collection and abstraction, water storage, distribution and water application. This may include: • Small- or large-scale schemes; • low pressure or high pressure (gravity fed, sprinkler, or drip) systems; • market gardens; • spate irrigation; • irrigated oases.
Water quality improvements	Measures that primarily aim to improve water quality, for example: • sedimentation traps; • filter / purification system; • infiltration ponds.
Gully control and other land rehabilitation measures	There are a whole range of different and complementary measures, though structural barriers dominate,often stabilised with permanent vegetation, including: • gully control using structural barriers; • reshaping to reduce landslip and vegetation stabilisation; • mining rehabilitation; • topsoil storage; • sloping and revegetation.

SLM Technology	Description
Sand dune stabilization	Fixing surfaces from being blown and transported by wind, such as sand dunes, light structured soils (e.g. as loess soils). The aim can be to reduce the material from being blown and / or to stop the shifting of dunes. Also includes stabilization of mine dumps.
Riverine and coastal bank protection	Vegetative and structural measures that protect land and infrastructure from erosion of river banks and coasts by flowing water, tides and impact of waves.
Protection against natural hazards	Measures to mitigate effects of floods, storms, earthquakes, stone falls, avalanches, landslides and mudflows.
Waste management	Organic and inorganic waste management, including: • solid waste (sewerage); • rubble littering; • effluent tailings; • bio-waste and chemical waste.
Biodiversity conservation and sustainable use	• Agricultural biodiversity conservation and sustainable management including maintenance of a wide range of plant varieties and livestock breeds and indigenous agricultural heritage systems for their current and potential future value • Conservation and sustainable use of natural habitats and rare and endangered or highly valued species (plant animal and microbial).
Protected areas	Certain areas may be protected for conservation, including: • forests; • wetlands; • biodiversity (i.e. specific species and habitats); • watersheds (for water supply, reduction of flood risk to downstream urban areas etc.) These may be supported through ecotourism.

Source: Questionnaire for Mapping Land Degradation and Sustainable Land Management, v2 (FAO-WOCAT, 2011) and SLM in Practice (FAO/TerrAfrica, 2011)

3

ANNEX

Case Study of a SLM Technology Assessment

Farmland shelterbelt on dryland

Aohan Banner of Inner Mongolia, China

The shelterbelt in the shape of grid can be established on dryland (rain-fed cropland) without irrigation. The technological demonstration plot is located in Aohan Banner, the eastern part of Inner Mongolia and the south of Horqin Desert. Hills and sandlot dominate this area. The demonstration plot is a semi-arid area with poor natural conditions. This area faces shortage of both surface and ground water resources, so most farmlands are rain fed. The crops often suffer from wind gusts and cold spells. Sometimes there is no harvest at all. Establishment of shelterbelts is an essential measure to ensure stable and high yield of farming products.

The key points of the technique are as follows:

1. Site selection – hillside land or sand-covered cropland with slope less than 15°.
2. Shelterbelt configuration – narrow belt, small grid with ventilation configuration. The main belt should be arranged perpendicular to prevailing wind direction and has three rows of trees at 2x2m spacing. The ancillary (side) belt should

left: Bird's-eye view of farmland shelterbelt on dryland – *Photo by Ding Rong*
right: Close shot of farmland shelterbelt on dryland – *Photo by Li Xianyu*

Location: Aohan Banner, Inner Mongolia
Technology area: 2000 km^2
SWC measure: vegetation
Land use: cropland
Climate: sub-humid
WOCAT database reference:
Related approach:
Compiled by: Li Chunying, Inner Mongolia Forestry Department; Tian Lü, Inner Mongolia Forestry Survey and Design Institute.
Date: August 2007

Editors' comments: This technology is suitable for hill land and sand-covered rain-fed cropland. It needs less investment but produces good protection effect. At the same time, the forest belt at mature stage can be felled for timber use to realize ecological and economic benefits. Now, this technology has been widely extended in areas with serious sand harm of Inner Mongolia autonomous region. This technology has good potential to be adopted for similar areas.

be perpendicular to the main belts and has two rows of trees at 2x2m spacing. The spacing of main belts is 300m and that of ancillary belts 400-500m.

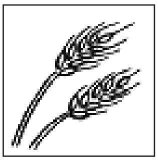
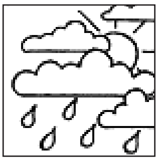
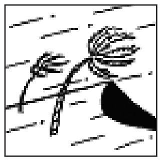
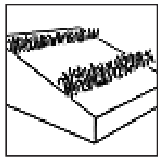
3. Species selection - P. *X Simopyramidalis* chon-Lin CV, *Populus simonii × P. nigra* and *Populus X beijingensis* W. Y. Hsu or other tolerant and fast-growing poplars species or varieties.
4. Site preparation – conduct site preparation in rainy season one year before planting in a) semi-underground form, size: 4-6m long, 1m wide, 0.5m deep and dig the planting pit inside at 0.6x0.6x0.6m; topsoil is backfilled to 30cm. b) in level trough from size: 0.8m wide in upper opening, 0.6m basal width, 3-5m long and 0.5m deep; planting pits are arranged inside the trough in a delta form and topsoil is backfilled to 30cm.
5. Seedling preparation – "2-yrs old root and 2-yrs old stem" or "3-yrs old root and 2-yrs old stem ", 1cm in collar diameter, 1.5m in height for the seedlings. Dig out the seedlings several days before planting date and water well before lifting. Wet soil should be used to maintain moisture of the roots of the lifted seedling and wrap the roots with wheat straw or plastic cloth when the seedlings are to be trasnported. Soak them completely in water for 48h before planting.
6. Planting – April and May are best planting seasons. Place the seedling upright in the hole and backfill soil in layers and tread it firmly in each layer. Water the seedling sufficiently after planting and make 20-30cm high drought-resistant soil pile surrounding the seedling. Adopt watered planting method to the hole or use film mulching plantation if possible.
7. Maintenance measures – build wall at 1m distance to trees of edge row (1m wide in the opening, 0.8m wide at the base, 1m deep), to prevent damage by humans or livestock. Tending should be done once in spring and once in autumn over three consecutive years for soil loosening, weeding and watering. Guards shall be built to protect the trees.

The farmland shelterbelt in Aohan Banner has produced good economic and ecological benefits. Observations show that farmlands guarded by shelterbelts have less wind erosion and increased resistance to natural disasters and 10% increase in crop output. On September 3, 1996, early frost struck Chifeng region of Inner Mongolia and the farmland in Aohan had minor damage, while the lands without shelterbelts were affected by reduced crop output. Estimates show that each hectare of forest can give an increase of five cubic meters of growing stock. Such remarkable predictable economic benefits promote great enthusiasm of farmers to participate. At present, almost all dry lands in Aohan Banner have farmland shelterbelts.

Classification

Land use problems

- serious wind erosion
- crops are easily affected by extreme weather conditions
- land economic benefits is low in general

Land use	Climate	Degradation	SWC measure
			
Cropland, potato	Sub-humid	Wind erosion	Biological measurer

Technical function/impact

main:
- reduce wind erosion
- prevent sand burials
- prevent the crops from mechanical or freezing harms

secondary:
- reduce evaporation
- improve micro climate of the farmland

Environment

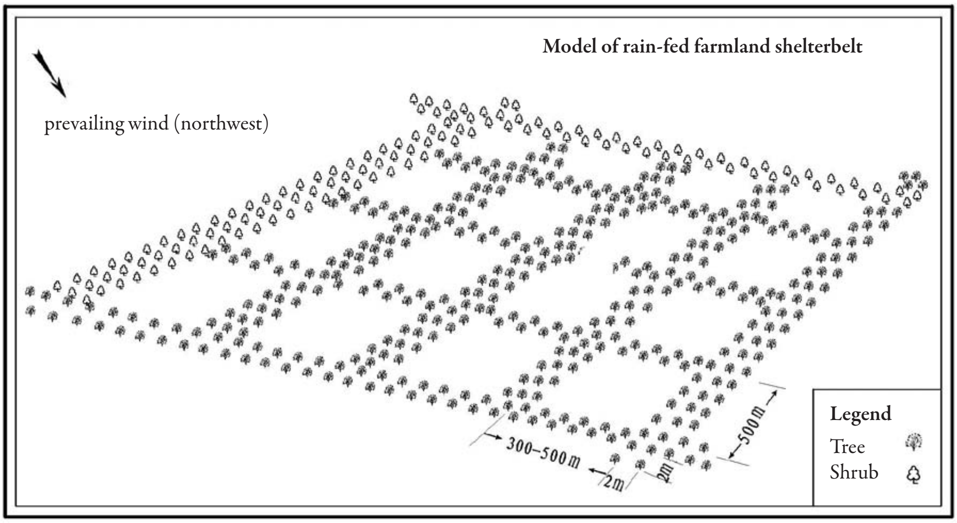
Natural Environment

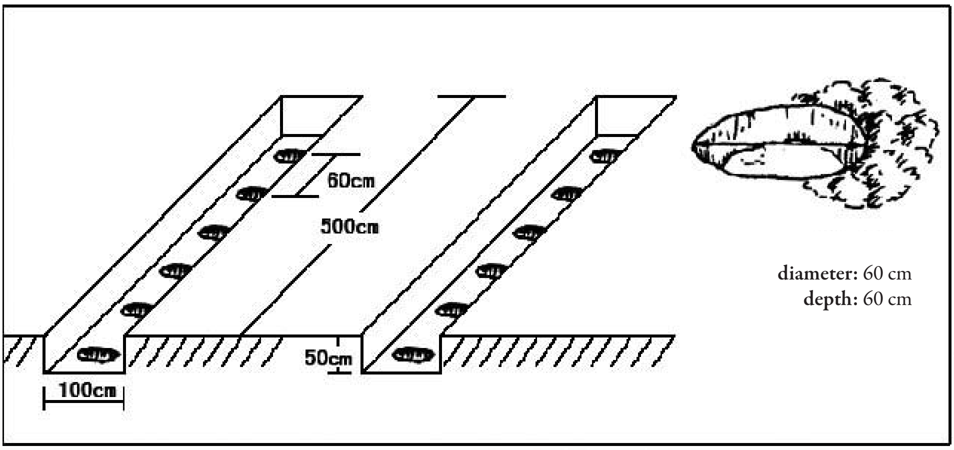
Average annual rainfall (mm)	Altitude (m a.s.l.)	Landform	Slope (%)	Soil depth (cm)
>4000	>4000		very steep (>60)	0–20
3000–4000	3500–4000		steep (30-60)	**20–50**
2000–3000	3000–3500		hilly (16-30)	50–80
1500–2000	2500–3000		rolling (8-16)	80–120
1000–1500	2000–2500		moderate (5-8)	>120
750–1000	1500–2000		gentle (2-5)	
500–750	1000–1500		flat (0-2)	
250–500	**1000–500**			
<250	<250			

Growing season: 150 days in succession, from April to September
Soil fertility: moderate
Soil texture: moderate (loamy)
Surface stoniness: no
Topsoil organic matter: moderate (1–3%)
Soil drainage: moderate
Soil erodibility: high

Human environment

Mixed land per household (ha)	
<1	**Land use rights:** individual
1–2	**Land ownership:** collective
2–5	**Market orientation:** self use
5–15	**Level of technical knowledge required:** moderate for technical extensionists and low to land user
15–50	**Importance of off-farm income:** less than 10% of the total income
50–100	
100–500	
500–1000	
1000–10000	
>10000	





Note:
Pattern design: spacing: 2×2m, two lines belt with grid size: 300×500m or 500×500m.
Semi-underground site preparation: 4–6m long, 1 m wide, 0.5m deep; Inside prepare the planting pits with size 0.6×0.6×0.6m.
Drawing by Guo Huimei, Inner Mongolia Forestry Monitoring and Planning Institute.

Implementation activities, inputs and costs

Establishment activities

1. Preparation investigation: determine location and technical methodology;
2. Farmer and government sign afforestation contract;
3. Planting design.
4. Selection of tree species.
5. Site preparation. Done at rainy season one year before planting.
6. Seedlings.
7. Planting. Put seedling upright the planting hole, fill in earth, tread and water earth.
8. Maintenance protection. One meter away from the trees of edge row, dig a gully with 1m wide at upper edge, 0.8m wide bottom edge and build walls aside the gully to avoid human or domestic animal damages. Three years of maintenance tending.

Establishmet time: 1 year.

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour (_15_person days)	54.9	100%
Equipment		
- tractor, water trasport vehicle	36.6	0%
Materials		
- seedling	609.8	0%
Agricultural		
TOTAL	**701.3**	**7.8%**

Maintenance/recurrent activities

1. Artifial weeding between forest belts, twice a year watering in spring and autumn;
2. Supplemental planting In spring of the year following the initial plating;
3. Arrange special guards for protecting shelterbelts.

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour (_10_person days)	36.6	100%
Equipment		
- tractor, water trasport vehicle	18.3	0%
Materials		
- seedling, pesticide	60.0	0%
Agricultural		
TOTAL	**114.9**	**85%**

Remarks: labor price at USD3.7/peron day; seedlings used during maintenance are for replanting; Exchange rate (at establishment): USD1= RMB 8.2 yuan

Assessment

Acceptance/adoption

With existing incentive mechanism, most households accept this technology;
Without incentive mechanism most households do not accept this technology;
If the comparative benefit of farmland shelterbelt is high, farmer households can accept the technology.

Benefits/costs according to land user	Benefits compared with costs	short-term:	Long-term:
	establishment	Neutral	Very positive
	maintenance/recurrent	Neutral	Very positive
The farmland shelterbelt brings to farmer households direct benefit, and government provides considerable subsidy, so the enthusiasm of farmer household is very high.			

Impacts of the technology

Production and socio-economic benefits		**Production and socio-economic disadvantages**	
+ + +	Improve the growth environment of the crops and ensure high and stable output of farmland	–	The trees have some effect on neighboring crops, and thus reducing crop output
+ +	Increase timber standing volume and generate economic income		
Socio-cultural benefits		**Socio-cultural disadvantages**	
+	Enrich farmers' knowledge of ecological improvement and protection	x	None
Ecological benefits		**Ecological disadvantages**	
++	Reduce wind erosion		None
+	Prevent sand burials		
+	Reduce evaporaion		
Off-site benefits		**Off-site disadvantages**	
+	Reduce sand dust weather days, absorbing carbon dioxide and releasing oxygen		None

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
Protection performance is good → further extension	Forest belt has effect on neighboring crops → introduce proper species and conduct root cutting to mitigate the effect
Have certain economic benefits → explore possibility of planting cash trees for higher output	Single tree species adopted → introduce more forest species suitable for shelterbelt

Key reference(s):

[1] Technique of farmland shelterbelt establishment on rain-fed farmland: Appropriate forestry technology. Inner Mongolia Forestry Departmetn.2001.116-118.

[2] Desertification combating and Management Center of State Forestry Administration, Applied technology and pattern of desertification control in China, Beijing. China environmental science press. 2001

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4

ANNEX

Sustainable Land Management approaches

A list of widely known SLM approaches in most regions is provided, derived from the WOCAT database.

SLM Approaches	Description
Participatory Research and Development (PRD) which includes **Participatory Learning and Action (PLA)**	A pool of concepts and approaches that enable people to enhance their knowledge of SLM and strengthen land users' innovative capacity. It is bottom-up, demand-driven and has partly evolved from technology development and dissemination efforts. It includes adaptive management of technologies to suit local contexts also the wider sharing and use of technology options and local innovations that build on local knowledge and resources. PLA refers to systematic learning processes to facilitate empowerment and capacity development of local people, including; • Participatory Rural Appraisal (PRA): approaches for analysis by rural people of their own realities and incorporation of the knowledge and opinions in planning and management of projects. (e.g. transect walks, maps, calendars, matrices, diagrams using locally available materials); • Participatory Monitoring and Evaluation (PME) primarily used in impact assessment and project management. Local people, community organisations, NGOs and other stakeholder agencies initiate and decide together how to assess results and who benefits, to analyse findings and identify follow-up actions.
Participatory Land Use Planning (PLUP)	Approaches for planning of communal or common property land, /communal lands which are often the most seriously degraded and where conflicts over land use rights exist. As a complement or alternative to national policy, new arrangements can be regulated through negotiation among all stakeholders and communally binding rules for SLM, based on planning units, such as social units (e.g. village) or geographical units (e.g. watershed) can be developed, including: • *Gestion des Terroirs* a participatory catchment approach used in francophone West Africa. It associates groups and communities with a traditionally recognised land area, aiding these communities in building skills and developing local institutions for implementation of sustainable management plans. It has focused on village / community level NRM through: i) technical projects (e.g. soil conservation); ii) organisational structures within which people arrange their livelihood strategies; and iii) the legal / administrative system by which use rights are enforced in practice; • Participatory and Negotiated Territorial Development (PNTD) contributes to SLM and rural development through negotiation, participation, dialogue, and creating partnership among stakeholders that leads to the consolidation of a territorial social pact to overcome the social and economic inequalities that affect rural populations (food insecurity, inequitable access rights, social marginalisation etc.).
Integrated watershed / landscape management (IWM)	These approaches aim to improve both private and communal livelihood benefits from a range of technological and institutional interventions across a specific watershed (the main geographic unit of intervention). The concept of IWM goes beyond traditional integrated technical interventions for soil and water conservation, to include proper institutional arrangements for collective action and market-related innovations that support and diversify livelihoods. This concept ties together the biophysical notion of a watershed as a hydrological landscape unit with that of community and institutional factors that regulate local demand and determine the viability and sustainability of such interventions (i.e. SLM).

SLM Approaches	Description
Community-Based Natural Resource Management (CBNRM)	The concept embraces a variety of concepts around participatory, community-driven and collaborative natural resource management, often with a focus on resources subject to communal rights. It is effective where decentralisation assists in institutionalising and scaling-up popular participation and moving from project-based approaches toward legally institutionalised popular participation, It is critical that there is sufficient transfer of powers to local institutions. • Landcare is a community-based approach focused on building social capital to voluntarily resolve local problems affecting the community while preserving land resources. It is based on an effective partnership with government and the broader society, including the business sector, in the form of financial and technical advice. In this way, technical knowledge from scientific sources can be integrated with indigenous knowledge and the skills of local people.
Community development / investment funds	Funds made available to communities for their own development efforts through decentralization processes. Depending on the specific situation (i.e. donor, context, local needs) the funds may be open or earmarked for specific purposes. The basic concept is that the community has sovereignty over and decides on the use of these funds within a specific domain (e.g. for agricultural intensification). Funds may be paid-back by individuals after some years to form a local 'revolving fund. Some such schemes broaden their scope and become, effectively, savings and credit schemes benefiting the community as a whole.
Extension, advisory service and training	Investment in training and extension to support the capacity of land users and other local and national stakeholders is a priority to adapt better to changing environmental, social and economic conditions, and to stimulate innovation. For example • Participatory Technology Development (PTD); • Promoting Farmer Innovation (PFI) / Participatory Innovation Development (PID); • Training and Visit (T&V); • Information and Communication Technologies (ICTs); • Commodity / market driven extension; • Entrepreneurship to support value chains, etc. These may be multiple strategies, combining e.g. awareness-raising, extension worker to farmer visits, training workshops and seminars, exposure visits, hands-on training, and demonstration plots. Or they may focus on informal farmer-to-farmer extension and exchange of ideas: this was the only form of 'extension' for thousands of years and is being rejuvenated through progressive projects. Trained 'local promoters' that become facilitators / extension workers under a project / programme, or contracting extension services to NGOs / other third parties (e.g. strategic partnerships by NGOs with government agencies, private sector and grassroots organizations to strengthen technical capacities for scaling-up successful initiatives while piloting innovative approaches).

SLM Approaches	Description
Innovative extension approaches that empower farmers' groups and innovators	Farmer Field Schools (FFS) for SLM (and 'Farmer Study Circles', which are more informal): A group learning approach which builds knowledge and capacity among land users to enable them to diagnose their problems, identify solutions and develop plans and implement them with or without support from outside. The school brings together land users who live in the similar ecological settings and socio-economic and political situation in the field. FFS provide opportunities for learning-by-doing. Extension workers, SLM specialists or trained land users facilitate the learning process. Initiatives for supporting local innovators identify traditional practices with a SLM potential and support recent innovations (e.g. self-help groups, self teaching). The 'approach' is basically through transfer of knowledge within a community and through generations. Land users continuously adapt and experiment with new seeds and plants, as well as new practices and technologies, in order to cope with changing environments and new problems. Spontaneous spread may have occurred either recently or through the ages as a tradition. Adoption can be supported by local institutions / community organisations such as land user groups, marketing cooperatives, irrigation and range management associations, women's groups, land user to land user extension groups etc. More attention and support should be given to local innovation as well as to traditional systems, rather than focusing solely on project-based SLM implementation of standard technologies.
Payments / Rewards for Ecosystem Services (PES)	A recent approach that includes: • **Carbon markets (CDM and voluntary markets)** in particular, offer incentives to mobilise investments to conserve or rebuild forests and vegetative cover, in favour of higher biomass, as well as other co-benefits (e.g. higher productivity, sustaining water and energy resources and resilience to climate change); • The **Clean development Mechanism** (CDM) allows emission-reduction (or removal) projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO_2. These CERs can be traded and sold, and used by industrialised countries to meet a part of their emission reduction targets under the Kyoto Protocol. The mechanism stimulates sustainable development and emission reductions, while giving industrialised countries some flexibility in how they meet their emission reduction / limitation targets. It was developed more for reduced emissions from the energy sector and works less well for productive forests and does not yet include agricultural lands; • **Payments for Reduced Emissions from Deforestation and Degradation (REDD and REDD+)** a well funded process supporting reduced GHG emissions form forest lands (not yet including agricultural lands); • **Pro-Poor Rewards for Environmental Services in Africa (PRESA)** a project providing technical and policy support to small-holder PES projects; • **Payments for improved water supply** downstream to land users for their contributions to upstream watershed management; • **Payments for biodiversity conservation and sustainable use:** e.g. management and controlled harvesting of wild species, maintenance of traditional varieties and animal breeds through; • **Labelling for specific products from designated areas of origin** (e.g. Champagne) or for sustainable practices used in their production e.g. fair trade tea and coffee.

Source: Questionnaire for Mapping Land Degradation and Sustainable Land Management, v2 (FAO-WOCAT, 2011) and SLM in Practice (FAO/TerrAfrica, 2011)

5

ANNEX

Case study of a SLM approach assessment

Terrace approach

China

Highly organised strategic campaign to assist land users in creating terraces: support and planning from national down to local level.

Before 1964, the slopes on China's Loess Plateau were cultivated up and down by machinery. Consequently soil and water were lost at high rates, and fertility and yields declined. Accessibility to cultivated land became more and more difficult due to dissection by gullies. The first terraces were established by self-mobilisation of the local land users. However there was no standard design. Furthermore, as the individual plots were very small and scattered all over the village land, terracing needed better coordination. Between 1964 and 1978, the local government at the county level took the initiative of organising farmers and planning terrace implementation according to specific technical design on a larger scale. At that time the land was still communally managed by production brigades. Through mass mobilisation campaigns people from several villages were organised to collectively terrace the land - village by village - covering around 2,000 hectares each year. Labour was unpaid.

left: Mass mobilization showing people from several villages helping each other. Initially, farmers were not paid but from the 1980s onwards farmers received cash and other support for their work. – *Photo from 'Terraces in China' Ministry of Agriculture*
right: Construction of terrace risers following instructions given by a specialist – *Photo from 'Terraces in China' Ministry of Agriculture*

Location: Zhuanlang County, Gansu Province, Loess Plateau Region, Northern China, Peoples' Republic of China
Technology area: 1 555 km²
Land use: cropland
Type of Approach: programme
Focus: mainly on conservation
Climate: semi-arid
WOCAT database reference: QT CHN45
Related technology: Loess Plateau Terraces
Compiled by: Wang Yaolin, Gansu GEF/OP12 Project Office, Lanzhou, Gansu, China; Wen Meili, Department of Resources and Environmental Sciences, Beijing Normal University, China; Bai Zhanguo, World Soil Information, Wageningen, Netherlands
Date: May 2002, updated March 2006

The Yellow River Conservancy Commission (YRCC) came into being in 1948 – and the Upper and Middle Yellow River Bureau in 1977. This gave greater impetus to the implementation of SWC in the Loess Plateau. After 1978, land use rights were allocated to individuals (though official ownership was still vested in the state). SWC specialists and county level SWC bureaus started to work with groups of farmers who had land use rights within a given area. Survey and design were carried out. The farmers organised themselves, consolidated the parcels of land, and after the conservation work was done they redistributed the terraced fields.

In the 1980s the government started to financially support land users involved in SWC projects. Subsidies ranged from (approx) US$* 20 / ha in projects at county level, to US$* 55 / ha for national projects (e.g. through the Yellow River Commission), and up to US$* 935 / ha when World Bank projects were involved – as in the recent past. Implements were provided by the farmers themselves. Then, in 1988 a nationwide project in SWC - which originally was proposed at county level – was approved by the national government. Furthermore, in 1991 a national law on SWC came into force. Protection of the Yellow River and associated dams became a priority at regional and national levels. In total, within Zhuanglang County, 60 SWC specialists /extensionists cover an area of 1,550 km^2 and most of the terraces were built with low levels of subsidies. Annual plans about implementation of new SWC measures were made during summer. Small areas were planned at village or township level, whereas bigger areas (> 7 hectares) were designed at county level. Implementation then took place during winter. Terracing was implemented first where access was easiest and closest to settlements, and only later, further away.

Problem, objectives and constraints

Problems

- Lack of organisation, capital and technical knowledge in farmer communities to counter the underlying problems of water loss, soil loss, fertility decline and downstream effects on the Yellow River (floods and sediment) at catchment level.
- Absence or poor maintenance of erosion control measures.

Aims / Objectives

- Water conservation (this is a semi-arid area)
- Soil conservation: reduce soil loss on the sloping and erosion-prone land of loess plateau
- Enhancing soil fertility, and consequently production
- Improve people's living conditions

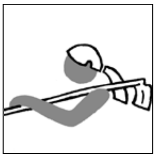
These primary objectives were to be achieved by building level bench terraces on a large scale through a structured and organised campaign. Finally at the national level, a fourth aim was added: the protection of the Yellow river (avoiding floods and reducing the sediment load).

Constraints addressed

	Constraints	Treatments
Legal	Land users leased the land from the state and land users' rights were insecure in the long term. Investments in SWC were not encouraged.	National government persuaded land users to implement terraces by 'selling' the benefits (increased yield and easier workability of the land). After 1978, individual user rights motivated farmers to invest in SWC.
Technical	Poor knowledge of how to reduce water loss, soil loss and fertility loss. Technical solutions were needed at the catchment level, involving the whole population.	Enhanced guidance by SWC specialists.
Financial	Initially farmers were not paid and as they had no immediate benefit from, or security over, the use of the land. The investment in construction was a heavy burden on poor farmers.	After 1988, labour inputs by farmers started to be partly covered by subsidies provided by local and national government.

Participation and decision making

Target groups



Land users

Planners

Politicians/
decision-makers

Approach costs met by:

Government	10%
Community/local*	90%
TOTAL	**100%**

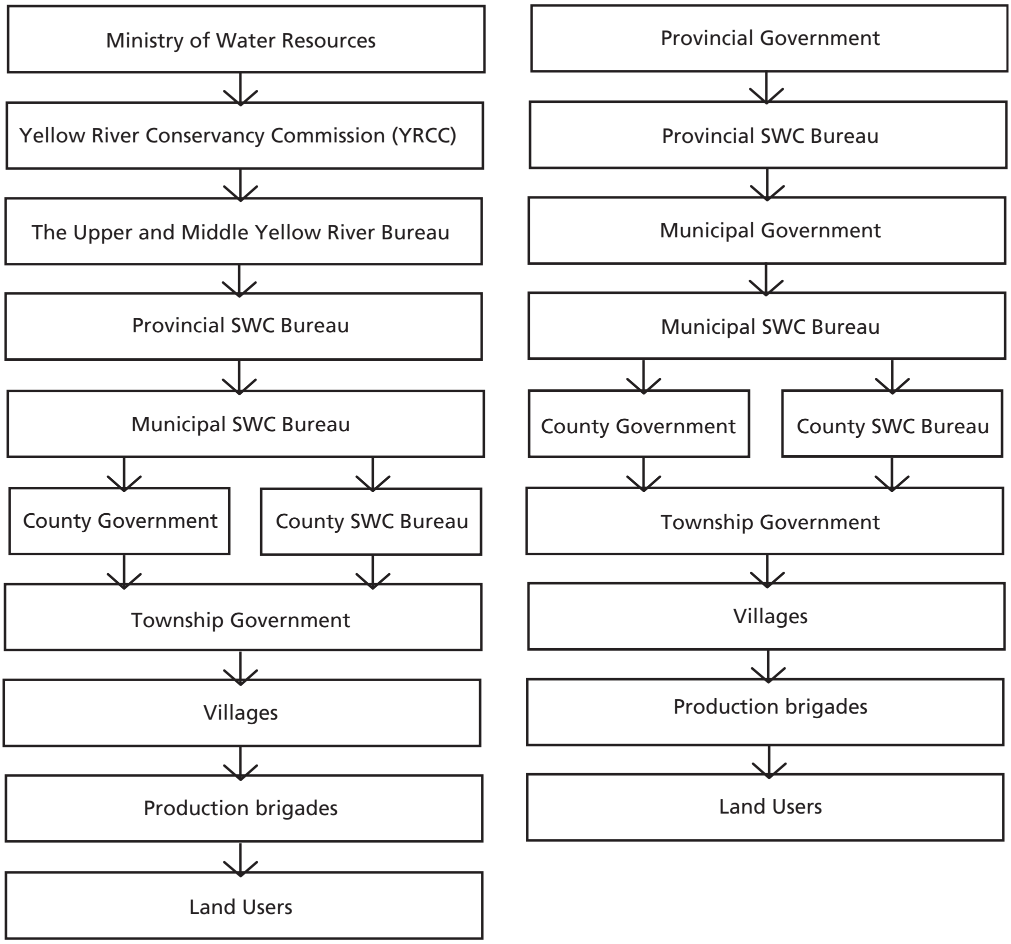
Annual budget for SLM component: 2 000-10 000*

Decisions on choice of the Technology (ies): Mainly made by SWC specialists with consultation of land users
Decisions on method of implementing the Technology (ies): Decisions are made by politicians / SLM specialists; land users are consulted in the planning phase (experienced farmers may be involved initially).
Approach designed by: County level and national specialists.
Implementing bodies: government.*

Land user involvement

Phase	Involvement	Activities
Initiation/motivation	Self-mobilisation/interactive	Land users started implementing terraces but SWC specialists at the country level assisted in designing standards for terrace construction and township governments and production brigades organised whole villages and watersheds.
Planning	Passive	Being consulted in the planning phase. Experienced peasants may be involved in introducing the local situation.
Implementation	Interactive	Major organisation done through the SWC bureau specialists with the village organisation including land users. Land users were actively involved in implementation.
Monitoring/evaluation	none	Reporting. No participation of land users.
Research	none	On-station research. No participation of land users.

Differences between participation of men and women: For manual labour, men can do more work and they have greater technical knowledge and skills related to terrace construction than women.*
Involvement of disadvantaged groups: Yes, moderate*



Organogram
Terrace construction supported by projects from MWR, YRCC and international organizations (left) and terrace construction supported by provincial funds (right)

Technical support

Training / awareness raising: Until 1978 the 'pyramid system' was used: the county level trained the township level, which trained the village level, which in turn trained the production brigades/farmers, who then trained other production brigades and farmers.
Training was on-the-job, focussing on design and construction of terraces on sloping land (provided by the county level specialists and by land users from villages where implementation was already carried out; at a later stage national trainers were involved as well). With respect to courses, demonstration areas, and farm visits – these were effective for all target groups.
Advisory service: The pyramid system is also used for extension. At each government level (at the county, district and provincial levels) there is a SWC division which is in charge of SWC activities including extension (demonstration, farm visits, etc). Effectiveness with respect to land users has been good. With rural economic development, more and more land users plan to invest in the SWC activities, including terrace making. The extension system is quite adequate to ensure continuation of activities.
Research: Mostly on-station research; carried out at the provincial and national levels, mostly by technical staff. Land users have not been involved. Topics covered include economics/marketing, ecology, technology. Terrace building is based on scientific design, according to local conditions.

External material support / subsidies

Contribution per area (state/private sector): no
Labour: In the 1960s and 1970s farmers were not paid for their labour inputs. From the 1980s onwards the government started to reward the community for establishment of terraces with cash: projects paid on the basis of area treated, and at different rates.
Input: Shovels and carts were provided by land users.
Credit: Credit was available at interest rates (0.5-1% per year) lower than the market rates.
Support to local institutions: Financial support to local institutions was made available through SWC Bureaus.

Monitoring and evaluation

Monitored aspects	Methods and indicators
Bio-physical	Regular measurements of runoff loss, sediment load, soil moisture
Technical	Regular measurements of structure of terraced areas, slope of risers, levelness of terrace surface
Socio-cultural	*Ad hoc* observations of land users' perceptions of terraces
Economic/production	Regular measurements of yield, income of land users.
Arera treated	Regular measurements of terraced area
No. of land users involved	*Ad hoc* measurements of the numbers of farmers directly involved in terracing and farmers benefited directly
Management of Approach	*Ad hoc* observations of number of small watersheds terraced

Changes as result of monitoring and evaluation: The approach changed fundamentally from self-mobilisation to organised mass movements guided by the government

Impacts of the Approach

Improved sustainable land management: Soil and water management have improved a lot: easier workability, intensified land use, in-situ water retention, top soil and fertilizer/manure are not washed away, etc.
Adoption by other land users / projects: As the Zhuanglang area was one of the pioneering areas for the Loess Plateau other regions were able to profit from the approach. But likewise, experiences gained in other counties helped improve the approach, and a basically similar approach has been applied over the whole Loess Plateau – though the level of subsidies for construction is much higher under World Bank projects.
Improved livelihoods / human well-being: Yes, little*
Improved situation of disadvantaged groups: Yes, little*
Poverty alleviation: Yes little*
Training, advisory service and research: Many people from different levels are trained, training effective.*
Land/water use rights: The ownership of the land and its resources belongs to state and communities: land users can only lease the land for a period of time. Due to uncertainty over future user rights and possible reallocation of the land every few years (5, 10 or 20) by the village in response to changes in population and household needs, additional investments into land/SWC measures may be hindered. 1978 a first major change took place by allocating some individual land use rights.
Long-term impact of subsidies: As more and more payment is currently being made to land users on the basis of the area treated, land users rely more and more on being paid for investments into SWC. The willingness to invest in SWC measures without receiving financial support has decreased. Thus the use of incentives in the current approach is considered to have a negative long-term impact.

Concluding statements

Main motivation of land users to implement SLM: well-being and livelihood improvement*
Sustainability of activities: Given the recent escalation in payments made to land users for implementation under certain projects it seems that the costs will be too high to sustain. Currently the Ministry of Finance is demanding that in-depth cost-benefit analyses are carried out involving environmental, social as well as economic assessments.

Strengths and → how to sustain/improve[*1]	Weaknesses and → how to overcome
Efficient organisation, planning to cover a large area, which is very susceptible to land degradation.	High costs: farmers depend on external support from the government, they are not willing to invest their labour without payments (as it used to be in communist times) → new approach: give farmers loans for construction as now they use machines to do the work. In addition, search for cheaper SWC technologies and for improving the benefits.
Heavy investment made by the land users and local as well as national government to reduce land degradation	The steeper slopes which are also further away from the village, are now often not cultivated and maintained as they are too far and marginal in production. → solutions need to be found for these areas, eg afforestation.
Many people involved and trained at different levels (pyramid system; see training/extension); commitment by all stakeholders.	
The collective activities / organisation strengthens the community and enhances social stability and coherence within villages; collective activities are expanded to other sectors, such as road construction, supply of agrochemical inputs, etc.	
Farmers are getting direct benefits: marked increase in productivity, improved workability of the land, etc.	

[*1] no recommendations provided on how to sustain/improve the strengths in this case study.
* New questions, no information available from this case study. Possible answers are invented.

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