FAOWATER

AGWATER SOLUTIONS
Improved livelihoods for smallholder farmers

COUNTRY INVESTMENT BRIEF

Mapping and assessing the potential for investments in agricultural water management

Zambia

The Agricultural Water Solutions Project

The Agricultural Water Solutions Project aims to unlock the potential of smallholder farming by identifying, evaluating and recommending a variety of agricultural water management (AWM) solutions - including technologies as well as the necessary supporting policies, institutions, financing arrangements and associated business models. This is being achieved through a series of interlinked activities in the seven project sites in Africa (Burkina Faso, Ethiopia, Ghana, Tanzania and Zambia) and in India (Madhya Pradesh and West Bengal). These activities include:

- in-depth case studies,
- mapping areas to identify where solutions are likely to be most viable and have greatest impact,
- discussing AWM solutions and project findings with stakeholders, and
- formulating business models to turn these findings into practical plans.

The national level analysis

This note presents the result of the national analysis. The analysis gathers available thematic maps and district statistics, and combines them with national livelihood maps which have been established through an in-depth consultation process to identify opportunities to invest in AWM in support to rural livelihoods. The suitability of different AWM solutions is then assessed and quantified in terms of investment opportunities and potential number of beneficiaries.

The methodology

Contrarily to classical water investment planning processes, this approach focuses on addressing poor rural people's needs rather than focusing on the development of potentially suitable resources. In so doing, the demand for investments in water is compared to the supply (availability of water). The demand for investments in water varies according to the needs of the population. In order to capture this demand, the project has adopted a *livelihood mapping* approach. This note presents the different steps followed in the national analysis:

1. Map the main livelihood zones, responding to the following questions:
   - what are the different farmer typologies and rural livelihood strategies?
   - what are the main water-related constraints and needs in the different rural livelihood contexts?
2. Map the potential and opportunities to improve smallholders' livelihood through water interventions: estimate the number and percentage of rural households who could potentially benefit from AWM interventions.
3. Map the suitability and demand for a series of specific AWM solutions, showing where they have the highest potential impact on rural livelihoods.
4. Estimate the potential number of beneficiaries, the potential application area and total investment costs for each AWM solution in each livelihood zone.

FAO has conducted and coordinated a participatory AWM mapping process in each project country in close collaboration with national partners. These products have been developed through a stepwise approach including national level data collection and processing, case study analysis, and local consultation. The livelihood map was developed during a participatory mapping workshop which gathered a large number of national experts from different fields (agriculture, water, social sciences, geography, etc.) and institutions (government, universities, NGOs, etc.) as well as farmers groups. This process was organised in two phases: 1) the purpose of a first workshop was to set up the basis for the analysis and start depicting the relationships between rural livelihoods and AWM and 2) a second or series of events - both at national and regional levels - to review the maps and refine the criteria used to define the potential for AWM and the suitability of different technologies. The outputs of the workshop have been enhanced through further consultation with national and international experts and through secondary data analysis using available national and sub-national datasets and statistics.

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Mapping the livelihood context

Different people in different places have different needs

The purpose of livelihood maps

Livelihood mapping consists in identifying areas where rural people share relatively homogeneous living conditions, on the basis of a combination of biophysical and socio-economic determinants. The main criteria to establish livelihood zones are: the predominant source of income (livelihood activities); the natural resources available to people and the way they are used; the prevailing agroclimatic conditions that influence farming activities, and access to markets.

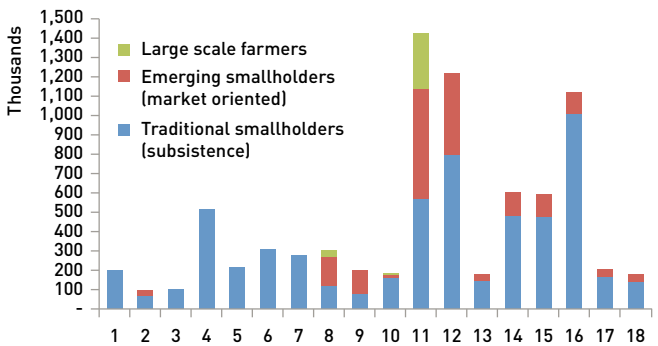
In the absence of detailed local level statistics, the livelihood map is a useful tool to understand rural people dependence to water (access, vulnerability, resilience to shock) and the extent to which investments in water are critical to their development.

The map of livelihood zones is the result of a participatory mapping process involving a wide range of experts, professionals and farmers representatives. Each livelihood zone is described in details in terms of the main smallholders' livelihood strategies, dimensions of poverty, their water-related problems and other constraints for development, and the role agricultural water management plays for their livelihoods. Combined with the map of rural population, the livelihood map makes it possible to assess the demand for water-related interventions in each zone.

Generally, livelihood zone boundaries would coincide with administrative boundaries, but not always. In practice, homogenous agroecological and socio-economic zones often cross larger administrative units. In these cases the delineation is based on other criteria which better capture the delineation between different livelihoods patterns (topography, climatic data, land cover data, etc.).

1: Grassland, cereals, cassava
2: Highly productive maize, tourism, timber
3: Game reserves, tourism, hunting
4: Fishing, livestock, rice
5: Medium-small holders, tobacco, maize, timber
6: Subsitence, cassava, fruits
7: Mining, traditional farming, sweet potato, beans
8: Copperbelt mining, labour, vegetables
9: Agro-pastoral, cattle, fishing
10: Agro-pastoral, cattle, fishing, tourism
11: Commercial, maize, cotton
12: Eastern plateau: agro-pastoral, maize, groundnut
13: Subsistence, cassava, cereals
14: Fishing, subsistence farming
15: Highland, beans, millet, trade
16: Shifting cultivation, cassava, cereals, groundnut
17: Commercial/subsistence, maize, cotton, cattle
18: Luangwa valley, millet, cotton, sorghum

Farmers Typologies



Traditional smallholder farmers:
These farmers produce mainly staple food (both crop and livestock) for household consumption and have relatively marginal connections to markets. The aim at stabilizing production and reduce risks of production failures.

Emerging market-oriented smallholder farmers
These farmers may partially subsist from their own production but whose principal objective is to produce a marketable surplus

Large scale farmers
These are large (commercial) farmers and Enterprises, oriented towards internal and export markets

Describing the livelihood context

from expert consultations

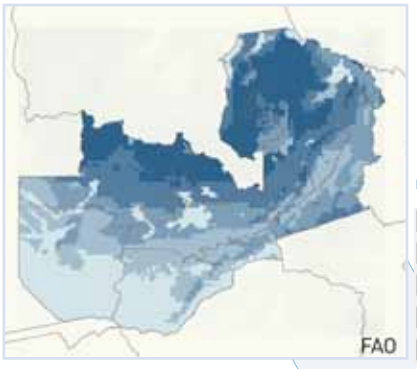
Dominant characteristics of livelihood zones

Zone	Name – major production systems	Description	Main livelihood sources	Market accessibility	Gender patterns
1	Grassland, cereals, cassava	Grassland area with (vulnerable) small scale farmers with cassava, sorghum, and cattle and timber	Cattle, Millet, Sorghum, Tourism, Timber	Low	Mainly male-headed households
2	Highly productive maize, tourism, timber	Agricultural area with small holder with maize of high productivity	Tourism, Sorghum, Timber, Vegetables, Cattle	High	Male and female-headed households
3	Game reserves, tourism, hunting	Forested area with game management reserves, game hunting or tourism activities (including livingstone area); small holder may benefit from employment but have restricted access	Tourism, Poaching, Hunting	Low	Male and female-headed households
4	Fishing, livestock, rice	Small holder farming with fishing, livestock, rice, cassava, millet, maize off season	Cattle, Cassava, Rice, Fishing	Moderate	Mainly male-headed households
5	Medium-small holders, tobacco, maize, timber	Smallholder with small to medium maize production, tobacco (cash crops), timber	Tobacco, Maize, Cattle, Timber, Grass	Low	Mainly male-headed households
6	Subsitence, cassava, fruits	Small holder subsistence farmers with fruits production (pineapple)	Cassava, Sorghum, Honey, Cattle, Pineapple	Low	Mainly male-headed households
7	Mining, traditional farming, sweet potato, beans	Mining/farming traditional (farmers going into mining)	Sweet Potato, Beans, Cassava, Mining	Low	Mainly male-headed households
8	Copperbelt mining, labour, vegetables	Mining mostly (but mining closing down) and some farming	Mining, Labor, Commerce, Vegetables	High	Male and female-headed households
9	Agro-pastoral, cattle, fishing	Smallholder agropastoral – livestock, crop, millet	Cattle, Fishing, Tourism, Maize	High	Male and female-headed households
10	Agro-pastoral, cattle, fishing, tourism	Agropastoral area, with smallholder, cattle, fishing, cash crops (cotton)	Sorghum, Cotton, Tourism, Millet, Fishing, Wheat	High	Male and female-headed households
11	Commercial, maize, cotton	Commercial farming (i.E. Sugar) and small holders with multiple crops	Maize, Cotton, Cattle, Tobacco,Wheat	High	Male and female-headed households
12	Eastern plateau: agro-pastoral, maize, groundnut	Agropastoral area with small holder– maize and groundnut, cotton and tobacco, tourism	Maize, Groundnut, Cattle, Tourism	Moderate	Mainly male-headed households
13	Subsistence, cassava, cereals	Small holder with subsistence farming, millet, cassava, sorghum	Maize, Cotton, Cattle, Vegetables	Moderate	Male and female-headed households
14	Fishing, subsistence farming	Fishing community with subsistence farming, cassava	Fishing, Cassava, Maize, Millet, Rice, Tourism,	Moderate	Mainly male-headed households
15	Highland, beans, millet, trade	Traditional small holder, beans, millet (high altitude)	Beans, Cattle, Millet, Vegetables	High	Mainly male-headed households
16	Shifting cultivation, cassava, cereals, groundnut	Traditional small holder farmer, groundnut, cassava, maize, slash and burn	Cassava, Fishing, Millet, Groundnut, Soybean	Moderate	Mainly male-headed households
17	Commercial/ subsistence, maize, cotton, cattle	Small holder, cotton, cattle, maize	Maize, Cotton, Cattle, Vegetables	Moderate	Male and female-headed households
18	Luangwa valley, millet, cotton, sorghum	Traditional small holder farmers, lowland, millet, cotton, sorghum	Millet, Cotton, Sorghum	Low	Mainly male-headed households

Mapping potential and opportunities for water interventions

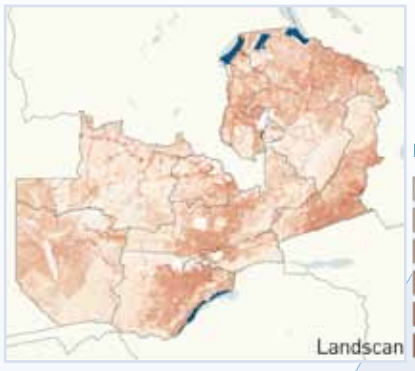
Criteria used

1. Water availability (runoff)



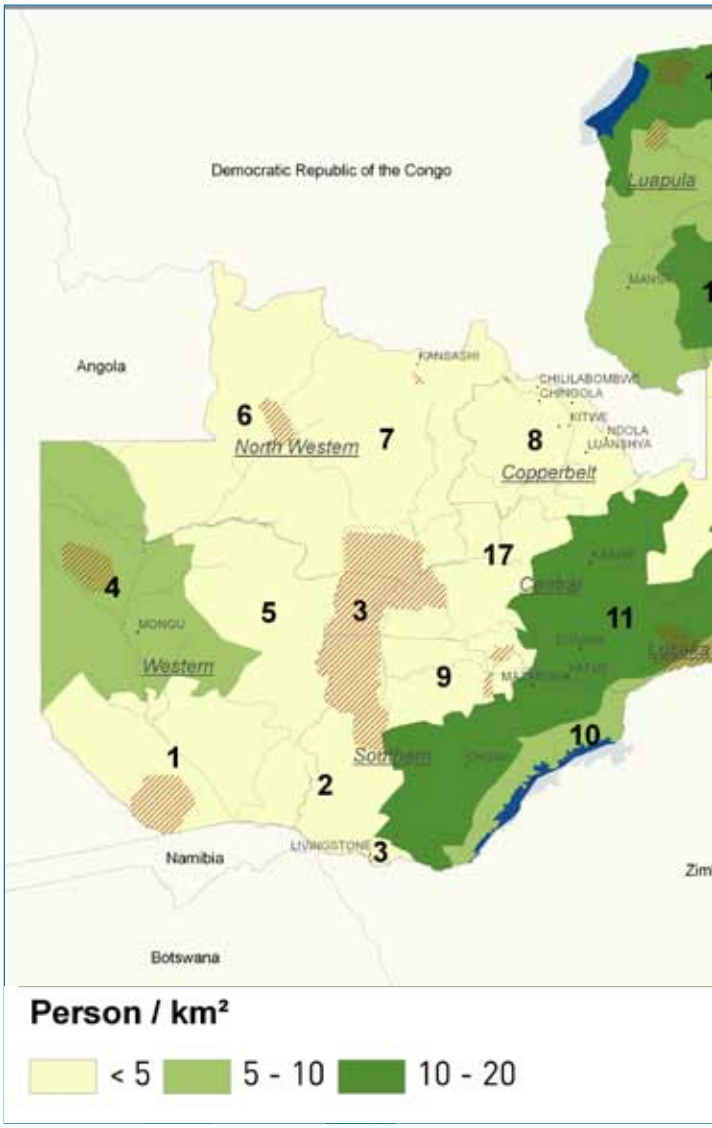
2. Perception of water as limiting factor for agricultural production

3. Rural population density



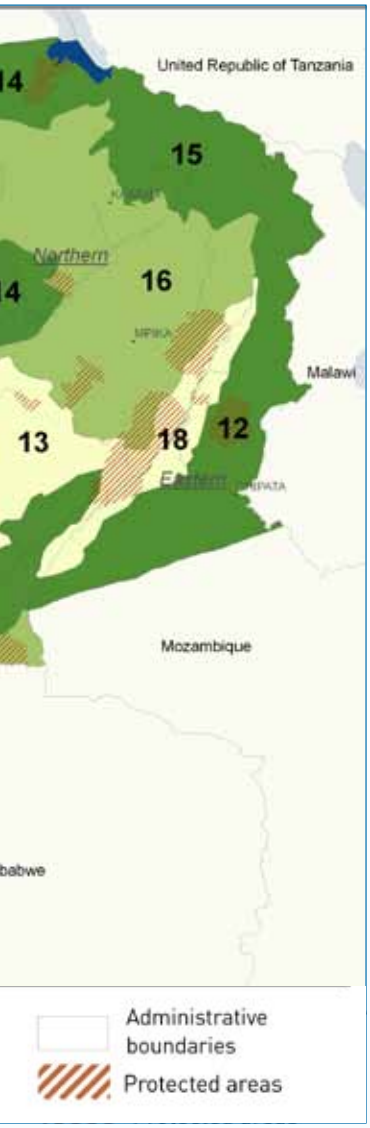
4. Poverty (underweight prevalence among children)

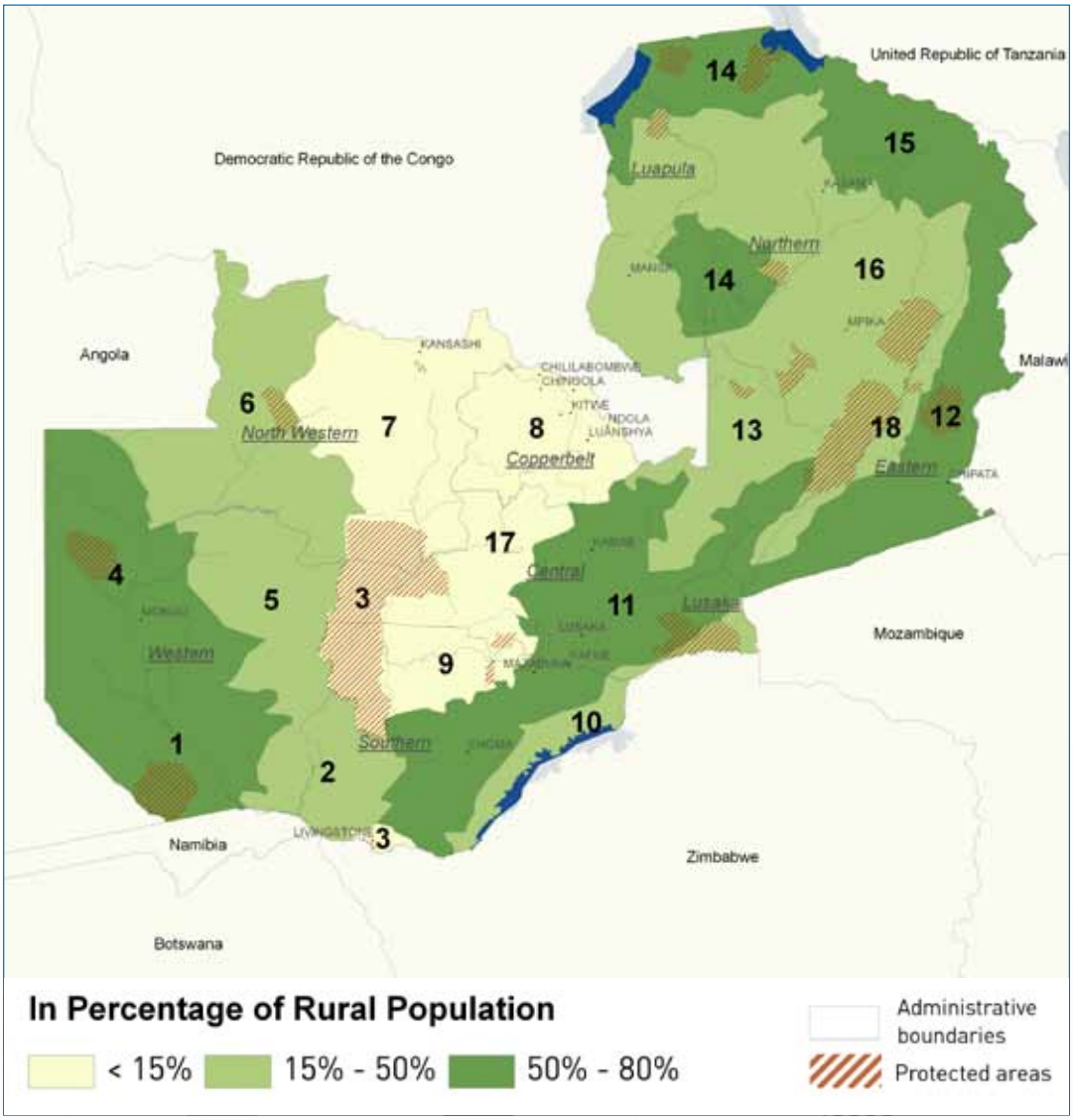
Number of potential beneficiaries



The potential for investment in water in support to rural livelihoods is a function of the demand from rural population and the availability of the resource. The maps above show a distribution of rural population who could benefit from water-related interventions. The level of demand is based on the analysis of the livelihood zones described before, combined with poverty level.

The supply is a function of availability of water, calculated on the basis of well established thresholds of water per person (water development being constrained below 500 m^3/pers.). These maps are generic.
The following pages show that the potential varies substantially as a function of the proposed technology.





Livelihood zone		Water availability: ($m^3/p/y$)	Rural population			Perception of water as limiting factor for agricultural production	Potential beneficiaries	
No	Name		Total (,000)	Density (p/km^2)	% poor (underweight)		Person (,000)	in % of rural population
1	Grassland, cereals, cassava	2,660	201	5	24	High	161	80%
2	Highly productive maize, tourism, timber	3,854	98	4	24	Medium	49	50%
3	Game reserves, tourism, hunting	18,354	102	4	26	Low	15	15%
4	Fishing, livestock, rice	3,923	516	9	24	High	412	80%
5	Medium-small holders, tobacco, maize, timber	7,644	218	6	24	Medium	109	50%
6	Subsitence, cassava, fruits	29,949	310	5	27	Medium	155	50%
7	Mining, traditional farming, sweet potato, beans	29,975	275	6	27	Low	41	15%
8	Copperbelt mining, labour, vegetables	15,451	306	13	29	Low	46	15%
9	Agro-pastoral, cattle, fishing	4,425	199	10	24	Low	30	15%
10	Agro-pastoral, cattle, fishing, tourism	2,393	187	12	23	Medium	93	50%
11	Commercial, maize, cotton	3,470	1,426	17	25	High	1,141	80%
12	Eastern plateau: agro-pastoral, maize, groundnut	4,499	1,220	24	32	High	976	80%
13	Subsistence, cassava, cereals	23,632	177	6	27	Medium	89	50%
14	Fishing, subsistence farming	10,739	606	16	33	High	485	80%
15	Highland, beans, millet, trade	6,264	600	21	34	High	480	80%
16	Shifting cultivation, cassava, cereals, groundnut	19,628	1,125	9	33	Medium	562	50%
17	Commercial/subsistence, maize, cotton, cattle	9,202	207	9	27	Low	31	15%
18	Luangwa valley, millet, cotton, sorghum	7,090	177	9	32	Medium	89	50%

Mapping the suitability and demand for specific AWM solutions

The AWM options

The project selected a series of promising AWM technologies on the basis of a baseline study, validated by a national workshop. The following solutions were retained and were the subject of in-depth research conducted by the project:

1. **Low-cost motor pumps (for surface water or groundwater abstraction)**
   Motorized pumps up to 5 HP that can lift and distribute water for farming practices. Their cost in Sub-Saharan Africa ranges from 200 up to 500 US$. They can irrigate a few hectares; smallholders in SSA use pump irrigation for high value crops, although they seldom exceed 1 ha of irrigated land per household. Farmers who have access to irrigation have substantially higher incomes and better food security than their neighbors who rely on rainfall. This needs a reliable method of drawing water from an available water source, whether it be a river, a reservoir, a pond, canal or groundwater.
2. **Soil and water conservation measures (*In-situ* water harvesting)**
   In-situ water harvesting is a variety of farming techniques which conserve rainwater in the soil. This improves the soil structure and moisture levels, which reduces the need for fertilizers and irrigation. As a result, yields and profits go up. *In situ* rainwater harvesting is important for staple crops and offers protection in low-rainfall years. These techniques can be quite labor intensive and need necessary capital and training.
3. **Dambos development (wetland rice)**
   Dambos are shallow wetlands found in higher rainfall flat plateau areas or bordering rivers . They are used for grazing, fishing, seasonal cropping, and increasingly for upland rice, representing a possible low cost, high potential option.
4. **Small reservoirs**
   Small reservoirs are earthen or cement dams that are less than 7.5 meters high. They can store up to 1 million cubic meters of water and sometimes have a downstream adjacent irrigation area of less than 50 hectares. Capital investment is generally externally driven and community management remains the norm.
5. **Community level river diversion schemes**
   Community managed river diversion (CMRD) schemes are a traditional irrigation method. They are usually temporary or semi-permanent dams and earthen canals that divert surface water from rivers. CMRD schemes are managed by farmers without external support. They are often characterized by poor infrastructure and water management, leading to low yields. Where river diversion schemes have been improved, the farmers earned considerably more than those in unimproved schemes.

For the 5 options a biophysical suitability and the potential demand based on livelihood conditions have been assessed and mapped and are presented further down.

Biophysical suitability

The map uses a set of criteria to assess the potential geographical extent of each AWM solution. These criteria represent the distribution of the biophysical conditions under which a AWM solution can have the potential highest impact on livelihoods. The maps show two levels of suitability:

- **High suitability: areas which present optimal conditions both in terms of biophysical and infrastructure conditions for adoption of a given AWM solution.**
- **Moderate suitability: areas where there are possibilities for application of a given AWM solution, but where conditions are less favourable.**

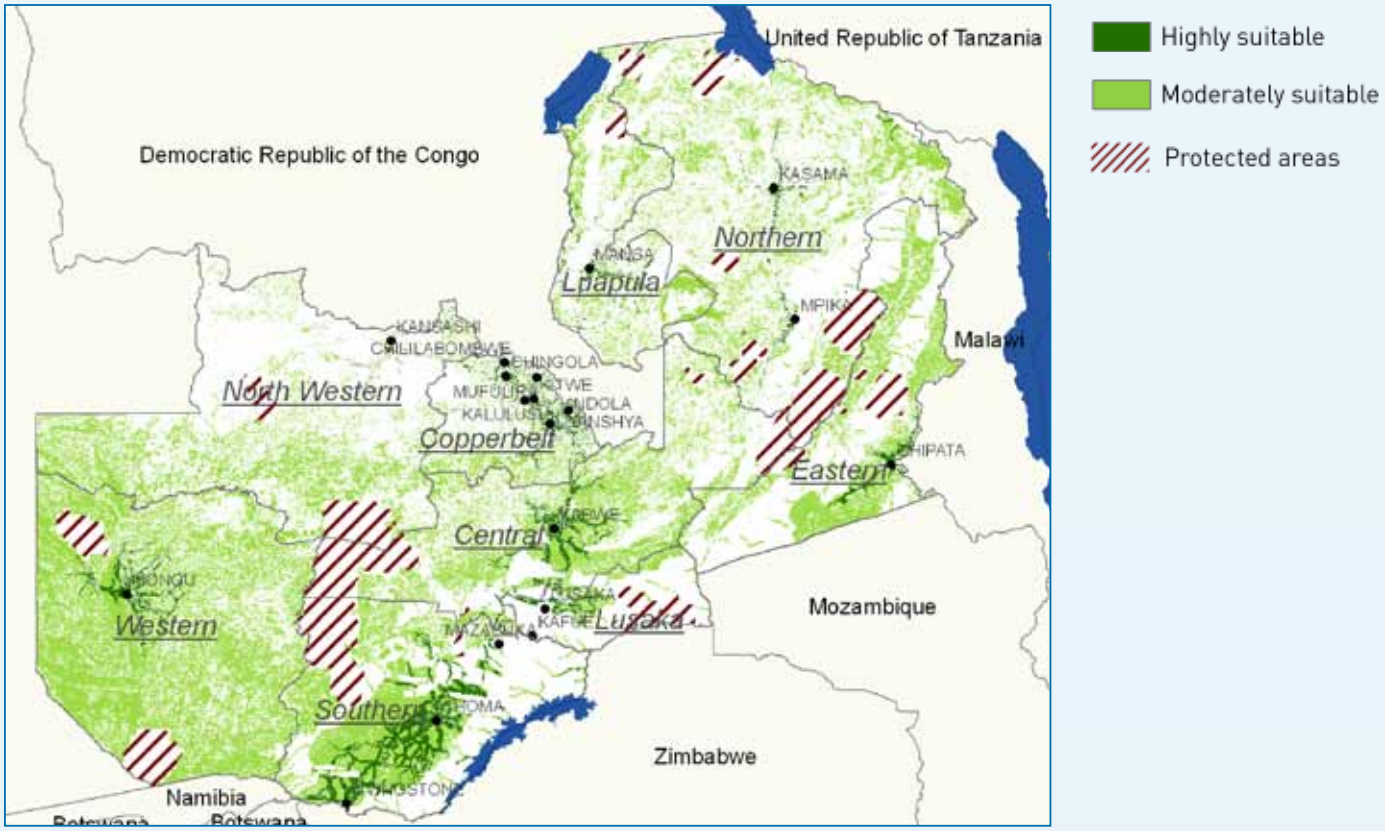
Livelihood-based demand

Local consultations and individual expert knowledge allowed expressing the potential demand for a technology among the population living in the different livelihood zone and provided more in-depth information on the potential adopters. These are for instance: farmer typology, vulnerability to shocks, dependence on water resources, and average landholding size.

The resulting map shows distribution of these factors in the different livelihood zones which, in turn, identify areas where livelihoods conditions are more favourable for a given AWM solutions.

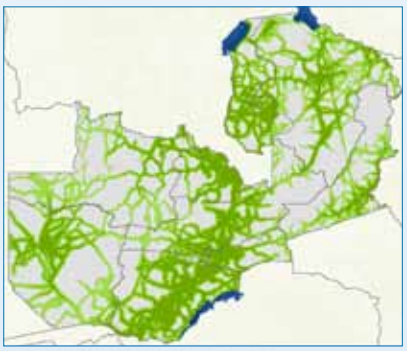
Solution 1: Low-cost motor pumps

Biophysical suitability



Biophysical criteria and conditions

Market accessibility (h)



Travel time to market centers

< 4 hrs | 4 hrs - 8 hrs | > 8 hrs

Distance to surface water + shallow groundwater

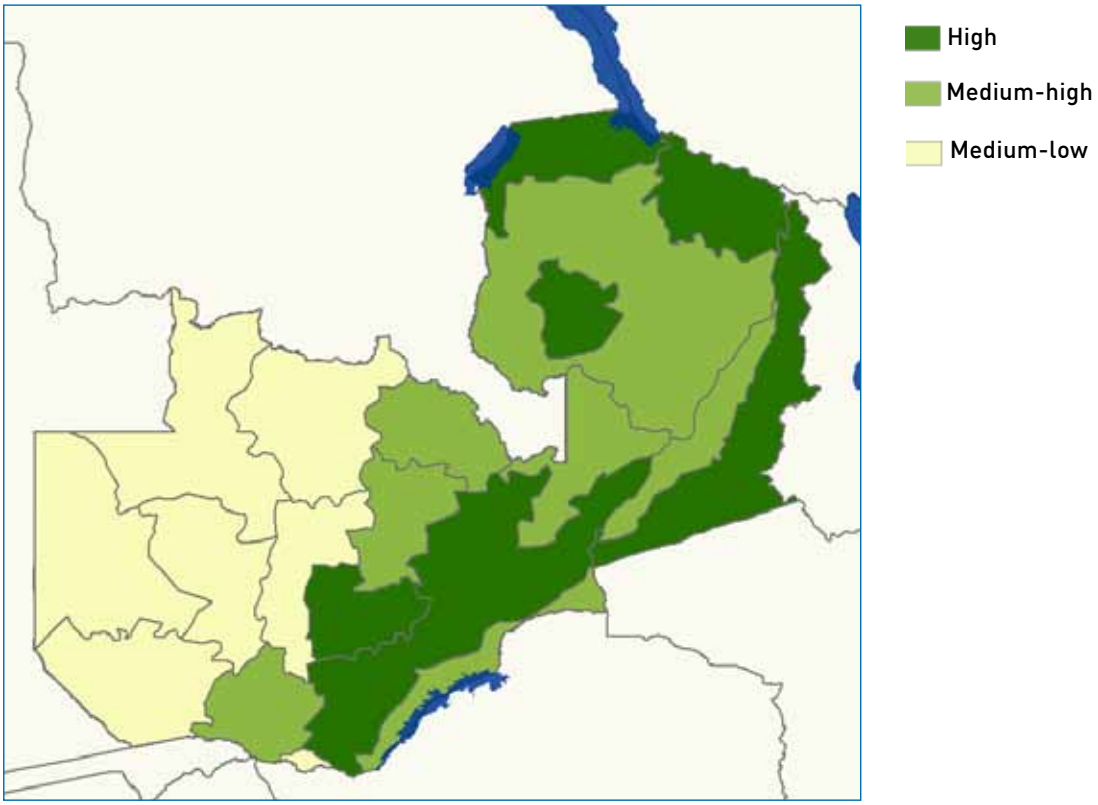
< 1 km distance from surface water

fluvisols/ gleysols / gleyic subunits

Livelihood-based demand

The livelihood-based demand is assessed through the analysis of the livelihood context of the zone. In particular, the context is assumed to be more favorable in zones with relatively higher prevalence of:

- **Market-oriented - smallholder farmers**
  This technology would imply higher production of high value crops for market sales. Therefore, this typology of farmers is considered to be more in demand of this technology
- **High population density**
  This indicate relatively higher pressures on natural resources therefore the need for intensification which is associated to this technology



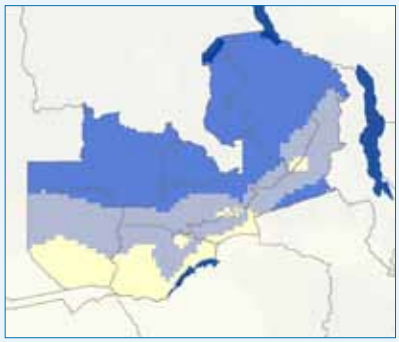
Suitability assumptions	Market accessibility	Surface water	Alluvial soils
Highly suitable	< 4 hrs travel time	<1km distance from surface water OR runoff > 300 mm/y	Presence of fluvisols/ gleysols/gleyic subunits in soil profile
Moderately suitable	4-8 hrs		
Unsuitable	> 8 hrs	> 1 km distance	

Physical suitability for small pumps has been assessed on the basis of: travel time to market (defined as centers of 20,000 inhabitants or more), with areas at 4 hours or less considered highly suitable and areas at more than 8 hours excluded, proximity to surface water, occurrence of soils with shallow groundwater potential (fluvisols, gleysols, gleyic subunits).

Solution 2: Soil and water conservation measures (In-situ water harvesting)

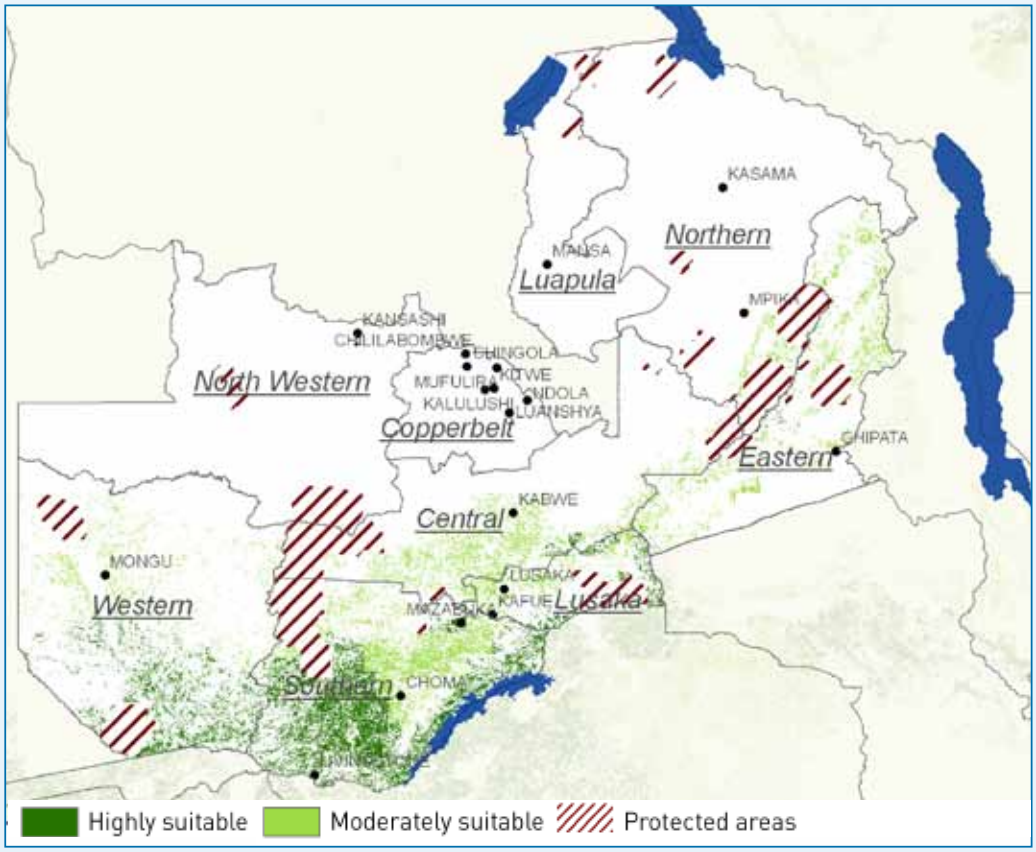
Biophysical criteria and conditions

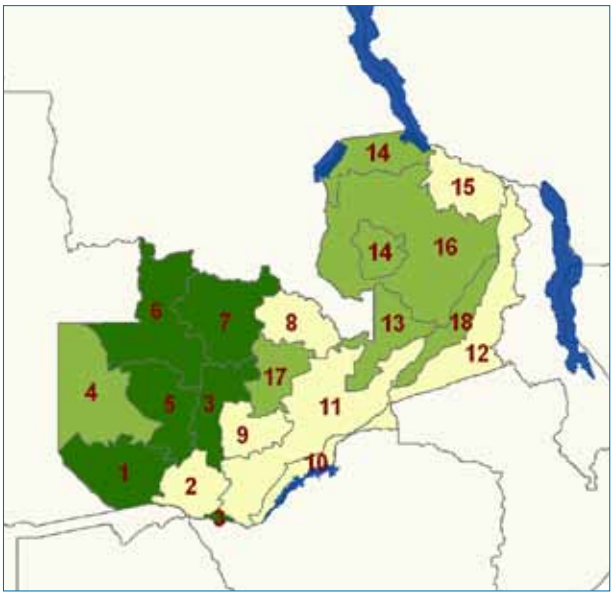
Aridity Index (P/ETref)



- < 0.05 Hyperarid
- 0.05 - 0.2 Arid
- 0.2 - 0.5 Semi-arid
- 0.5 - 0.65 Dry-subhumid
- > 0.65 Humid

Biophysical suitability





Livelihood-based demand

The livelihood-based demand is assessed through the analysis of the livelihood context of the zone.

In particular, the context is assumed to be more favorable in zones with relatively higher prevalence of:

- **Traditional smallholder farmers**
  The technology also requires less investments in assets. Therefore, this typology of farmers is considered to be more in demand for this technology.
- **Limited market accessibility**
  this technology aims at stabilizing the production of mainly staple corps and reducing crop failure rather than increasing production for sale.

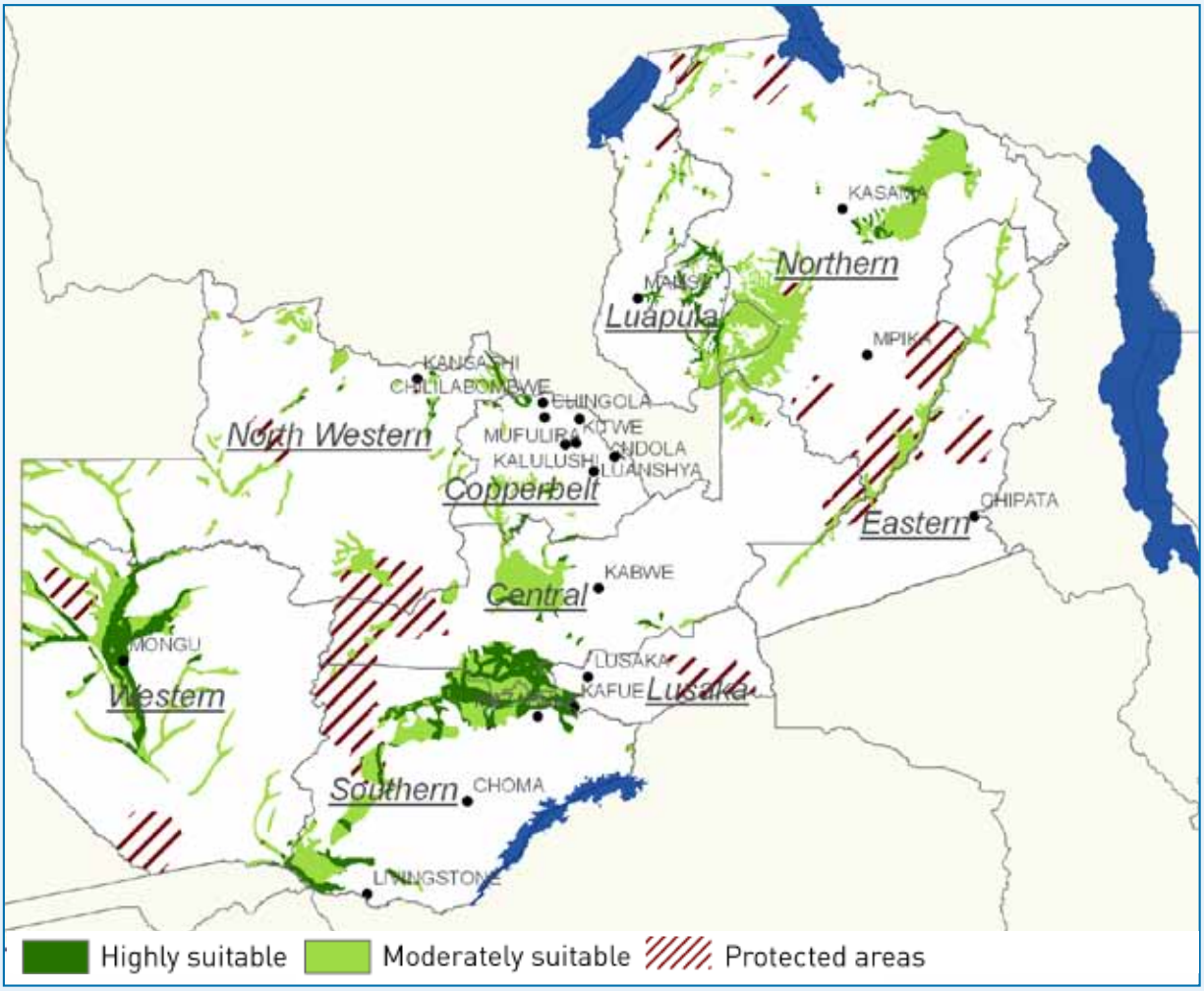
High | Medium-high | Medium-low

Suitability assumptions	Aridity index
Highly suitable	A.I. < 0.5
Moderately suitable	A.I. 0.5 - 0.65
Unsuitable	A.I. > 0.65

The physical suitability for Soil and Water conservation practices has been assessed on the basis of climate conditions. In-situ water harvesting (increased soil moisture retention) is assumed to be suitable in semi-arid (higher suitability) to dry-subhumid (medium suitability) cultivated areas.

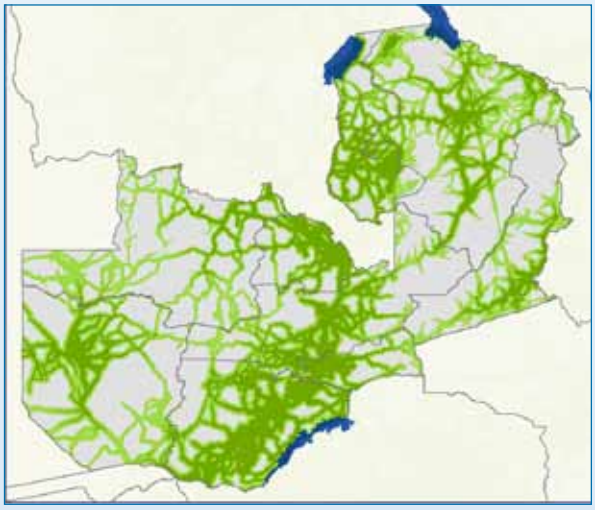
Solution 3: Dambos development (wetland rice)

Biophysical suitability



Biophysical criteria and conditions

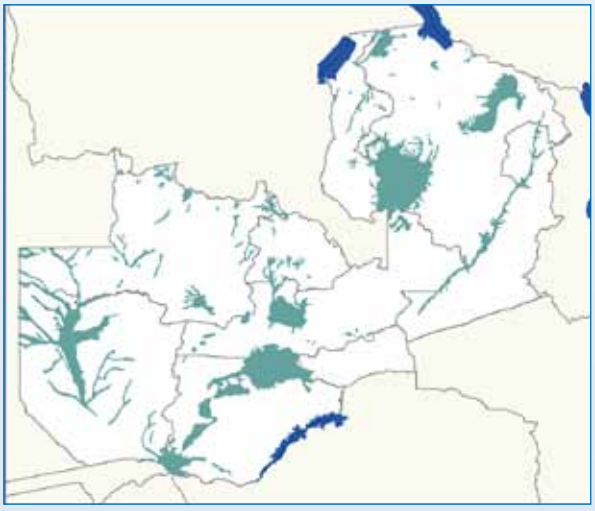
Market accessibility (h)



Travel time to market centers

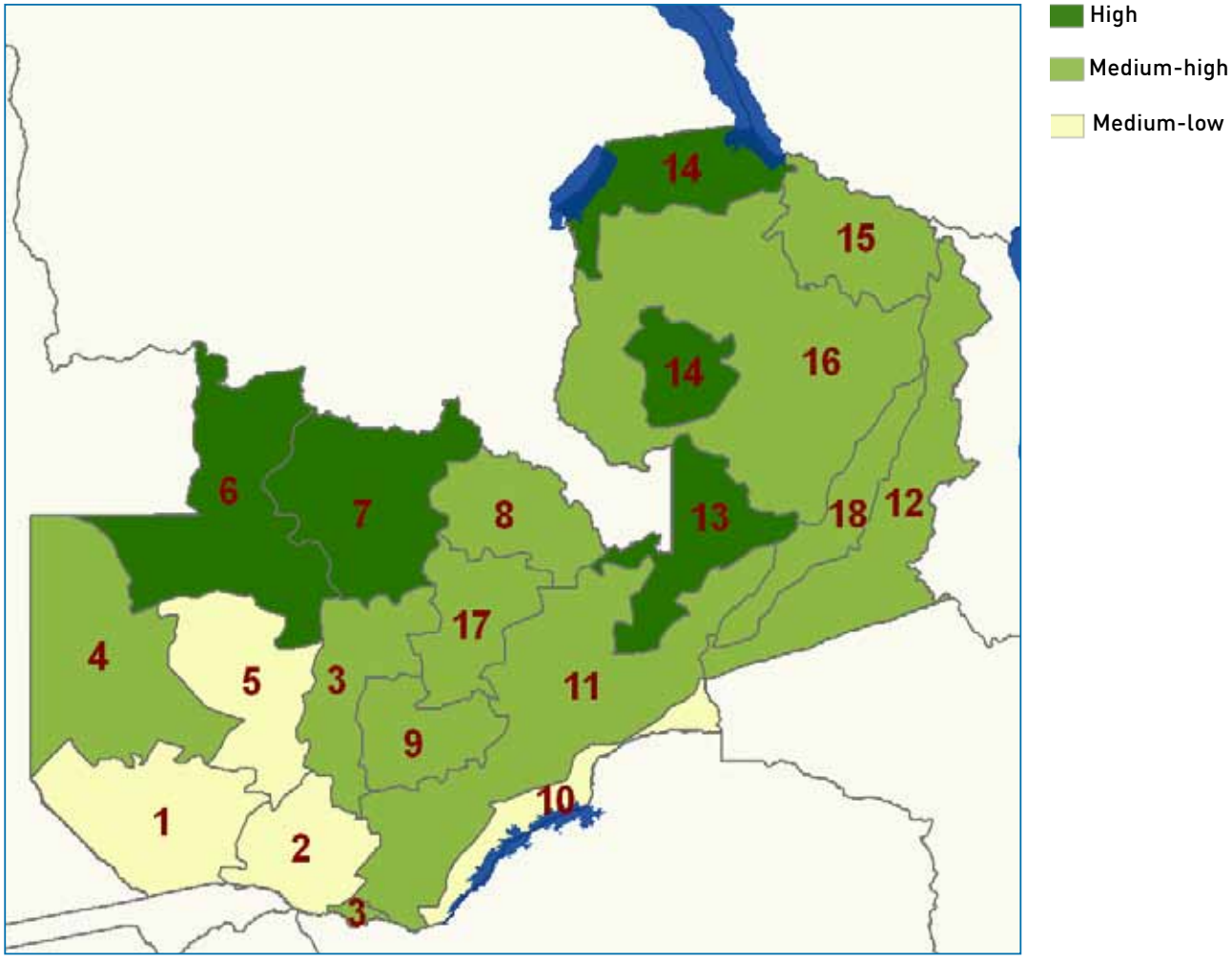
< 4 hrs | 4 hrs - 8 hrs | > 8 hrs

Dambos/Floodplains



dambos / floodplains

Livelihood-based demand



The livelihood-based demand is assessed through the analysis of the livelihood context of the zone. In particular, the context is assumed to be more favorable in zones with relatively higher prevalence of:

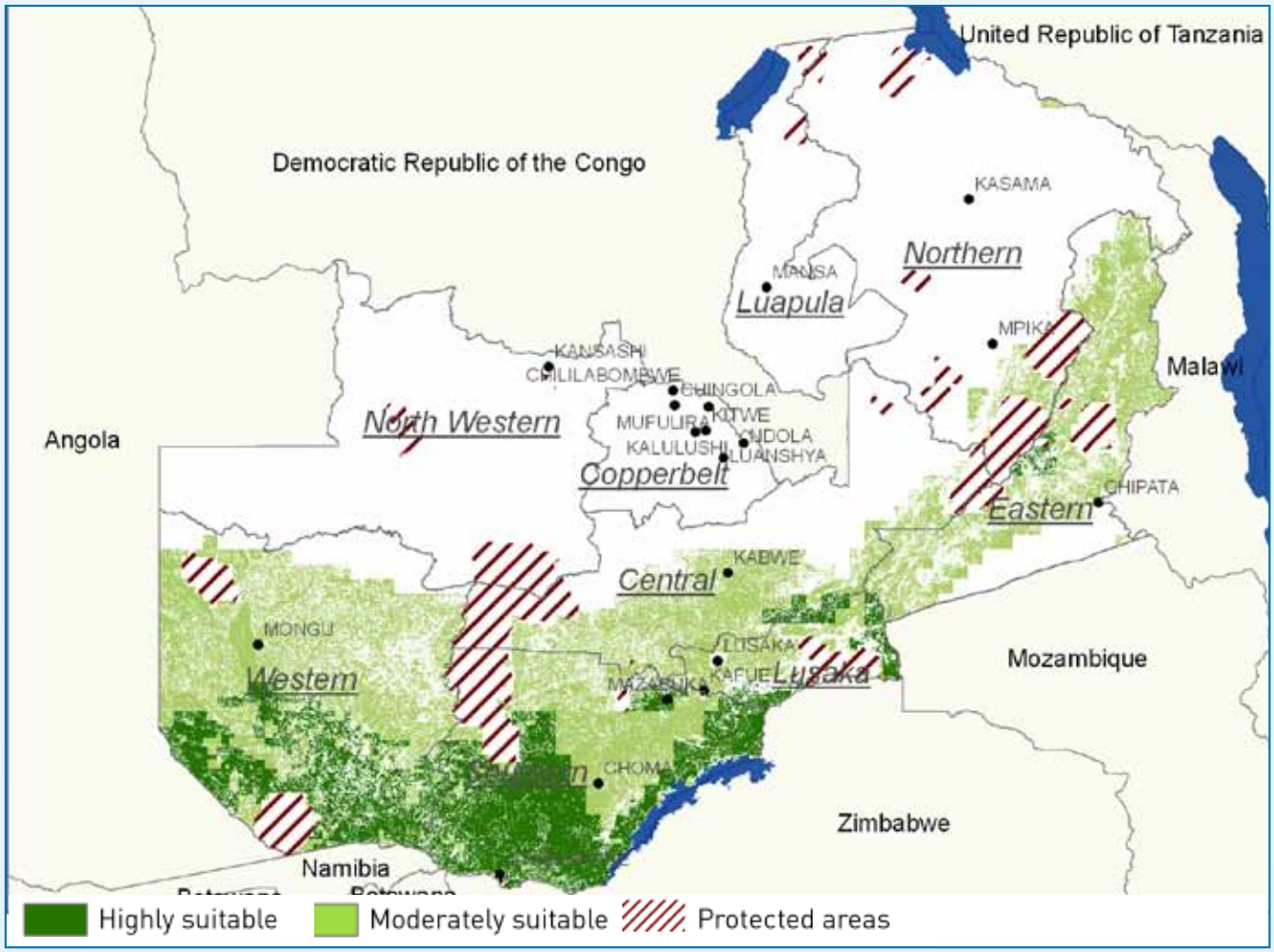
- **Traditional and emerging smallholder farmers**
  The approach requires low investments in assets. At the same time rice cropping can improve nutrition standards and can generate surplus for market. Therefore, both the typologies of smallholders can be considered to be more in demand for this technology.
- **High poverty rates**
  This technology is very labour-intensive and is suitable in large communities, offering employment particularly to landless people that are often the poorest. Therefore, areas with high poverty rates can be more in demand of this technology.

Suitability assumptions	Land cover	Market accessibility
Highly suitable	Wetlands (dambos/flood plains)	< 4 hrs travel time
Moderately suitable		4-8 hrs
Unsuitable		

Physical suitability for Wetland Rice has been assessed on the basis of land cover characteristics (flood plains, swamps, dambos) and travel time to market (defined as centers of 20,000 inhabitants or more), with areas at 4 hours or less considered highly suitable and areas at more than 8 hours excluded.

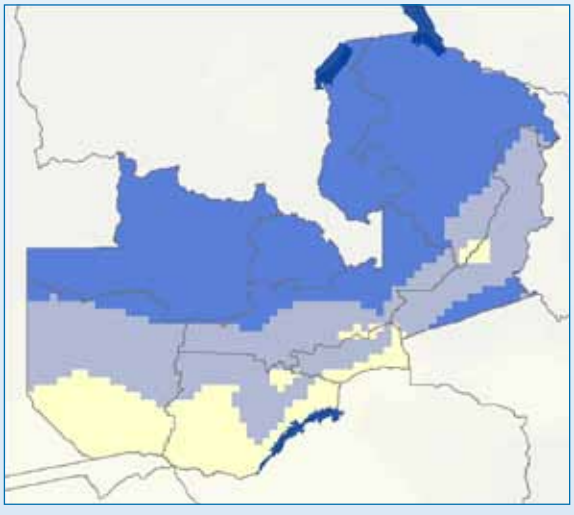
Solution 4: Small reservoirs

Biophysical suitability



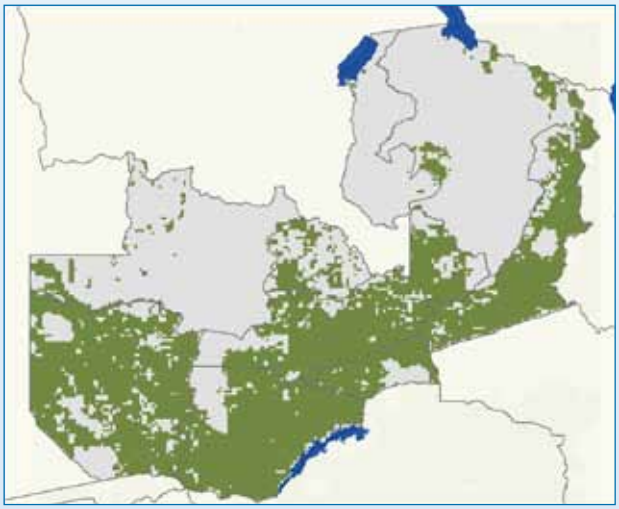
Biophysical criteria and conditions

Aridity Index (P/ETref)



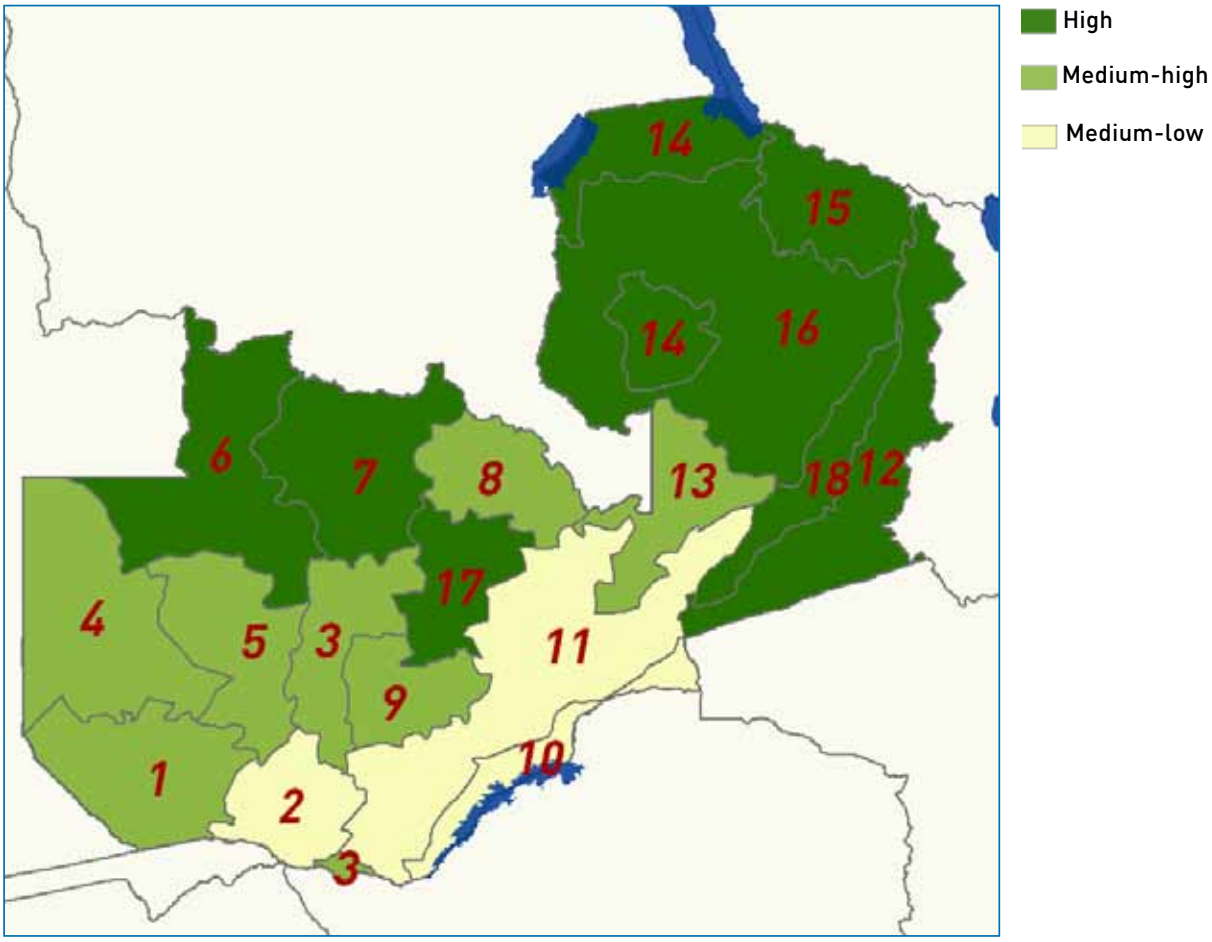
< 0.05 Hyperarid
0.05 - 0.2 Arid
0.2 - 0.5 Semi-arid
0.5 - 0.65 Dry-subhumid
> 0.65 Humid

Livestock density



Livestock density
< 1 unit / km²
> 1 unit / km²

Livelihood-based demand



The livelihood-based demand is
assessed through the analysis of the livelihood context of the zone. In particular, the context is assumed to be more favorable in zones with relatively higher prevalence of:

- **Traditional smallholder farmers with relatively higher prevalence of livestock-based livelihoods**
  Small reservoirs are one of the most important water sources for livestock in semi arid areas, particularly for traditional farmers that aim at stabilizing the production and improving nutrition rather than increasing production for sale
- **Higher poverty rates**
  this technology aims at providing water for multiple uses , i.e. cropping livestock water and domestic purposes. This multifunctional nature is crucial to contribute reduce vulnerability to shocks and increase resilience and therefore to alleviate poverty.

Suitability assumptions	Aridity	Livestock density
Highly suitable	A.I. < 0.5	> 1 TLU
Moderately suitable	A.I. 0.5 - 0.65	
Unsuitable	A.I. > 0.65	

Suitable area for small dams is here defined as agricultural area where Aridity Index (yearly precipitation divided by yearly reference evapotranspiration) is between 0.2 and 0.65, semiarid to dry-subhumid; in addition, a higher livestock density (Tropical Livestock Units) is assumed to be correlated with enhanced multiple uses of small dams.

Solution 5: River diversion

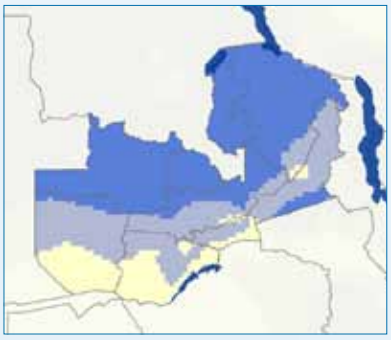
Biophysical criteria and conditions

Proximity to rivers

< 1 km distance from surface water

fluvisols/ gleysols / gleyic subunits

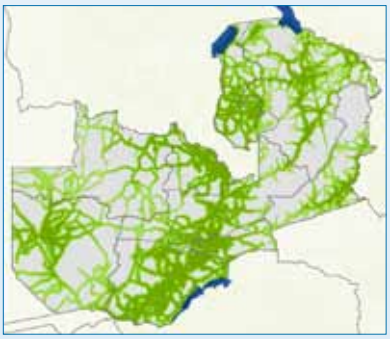
Aridity Index (P/ETref)



aridity

- < 0.05 Hyperarid
- 0.05 - 0.2 Arid
- 0.2 - 0.5 Semi-arid
- 0.5 - 0.65 Dry-subhumid
- > 0.65 Humid

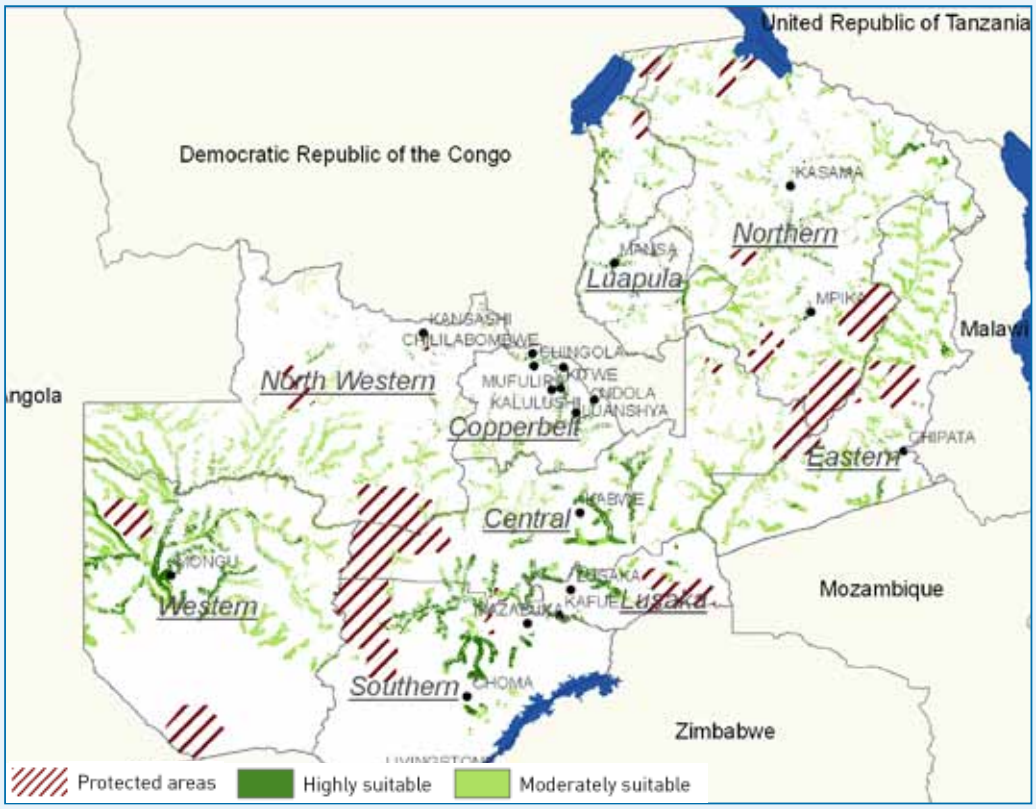
Market accessibility (h)



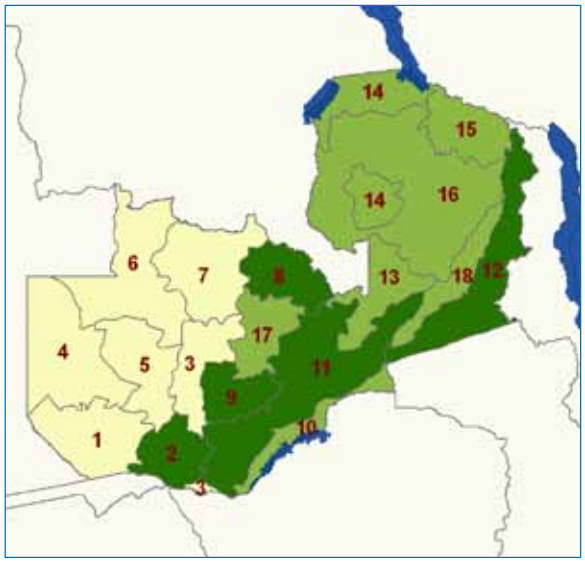
Travel time to market centers

< 4 hrs | 4 hrs - 8 hrs | > 8 hrs

Biophysical suitability



Livelihood-based demand



The livelihood-based demand is assessed through the analysis of the livelihood context of the zone. In particular, the context is assumed to be more favorable in zones with relatively higher prevalence of:

- **Traditional and market-oriented smallholder farmers** this technology would imply higher production of rice both for household consumption and market sales. Therefore, these typologies of farmers are considered to be more suitable for this technology.

Suitability assumptions	Aridity	Market	Distance from rivers
Highly suitable	A.I. >= 0.5	< 4 hrs distance	< 2 km from perennial rivers
Moderately suitable		4 - 8 hrs	
Unsuitable	A.I. < 0.5	> 8 hrs	> 2 km

Physical suitability for river diversion has been assessed on the basis of: travel time to market (defined as centers of 20,000 inhabitants or more), with areas at 4 hours or less considered highly suitable and areas at more than 8 hours excluded, proximity to surface water and aridity index.

Quantifying the potential for investments in AWM

Potential beneficiaries, application areas

Potential beneficiaries (rural households) - 50% of adoption rate

Livelihood zones	Low-cost motor pumps				Soil&water conservation measures				Dambo (rice)				Small Reservoirs				River Diversion			
	(,000 households)		(% total househ.)		(,000 households)		(% total househ.)		(,000 households)		(% total househ.)		(,000 households)		(% total househ.)		(,000 households)		(% total househ.)	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
1	-	9		21%	2	2	5%	6%	-	1		2%	8	13	19%	31%	-	-		
2	1	4	3%	22%	3	3	13%	15%	1	2	3%	8%	6	7	30%	35%	-	-		
3	-	1	1%	5%	-	-			-	-			1	1	3%	6%	-	-		
4	6	24	6%	22%	-	4		3%	9	13	8%	12%	1	27	1%	25%	5	8	5%	8%
5	-	8		17%	-	1		3%	-	-			-	10		21%	3	4	6%	8%
6	-	5		8%	-	-			-	3		5%	-	-			3	3	4%	4%
7	3	6	5%	10%	-	-			-	2		3%	-	-			-	-		
8	5	9	8%	14%	-	-			-	1		1%	-	-			-	-		
9	1	7	3%	18%	-	2		6%	4	6	8%	15%	1	13	4%	31%	1	4	2%	9%
10	1	2	2%	6%	6	7	14%	17%	-	-			12	15	32%	38%	-	-		
11	27	60	9%	20%	8	31	3%	11%	5	6	2%	2%	20	88	7%	30%	3	31	1%	10%
12	10	61	4%	24%	-	10		4%	-	-			-	44		17%	10	20	4%	8%
13	-	4		10%	-	-			-	1		2%	-	-			1	1	3%	3%
14	3	21	2%	16%	-	-			7	15	6%	12%	-	-			4	4	3%	3%
15	2	20	2%	16%	-	-			1	7	1%	6%	-	1		1%	2	2	2%	2%
16	6	20	3%	9%	-	-			2	6	1%	3%	-	1		1%	4	4	2%	2%
17	-	6	1%	15%	-	2		4%	2	5	4%	11%	-	5		12%	1	3	3%	6%
18	-	-			-	1		3%	-	1		4%	1	7	3%	19%	2	3	6%	8%
Total	**66**	**268**	**4%**	**16%**	**20**	**64**	**1%**	**4%**	**31**	**70**	**2%**	**4%**	**51**	**232**	**3%**	**14%**	**41**	**89**	**2%**	**5%**

Potential application area (ha) - 50% of adoption rate

Livelihood zones	Low-cost motor pumps				Soil&water conservation measures				Dambo (rice)				Small Reservoirs				River Diversion			
	(,000 households)		(% total househ.)		(,000 households)		(% total househ.)		(,000 households)		(% total househ.)		(,000 households)		(% total househ.)		(,000 households)		(% total househ.)	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
1	-	7		2%	11	12	2%	3%	-	1			8	13	2%	3%	-	-		
2	1	4		1%	13	14	2%	2%	1	3			6	7	1%	1%	-	-		
3	-	1		1%	1	2	2%	3%	-	-			1	1	1%	1%	-	1		1%
4	5	19	1%	5%	1	18		4%	13	20	3%	5%	1	27		7%	5	8	1%	2%
5	-	6		6%	-	6		6%	-	1		1%	-	10		9%	3	4	3%	4%
6	-	4		8%	-	-			-	5		10%	-	-			3	3	6%	6%
7	2	4	48%	98%	-	-			1	3	14%	59%	-	-			1	1	15%	15%
8	4	7	8%	14%	-	-			-	1		2%	-	-			-	-	1%	1%
9	1	6		2%		12		4%	5	9	2%	3%	1	13		4%	1	4		1%
10	1	2			27	32	6%	7%	-	-			12	15	3%	3%	-	-		
11	22	48	1%	2%	39	151	2%	7%	8	10	0%	0%	20	88	1%	4%	3	31		1%
12	8	49	1%	5%	-	46		5%	-	1			-	44		5%	10	20	1%	2%
13	-	3		6%	-	-			-	1		2%	-	-		1%	1	1	2%	2%
14	2	17	1%	7%	-	-			10	22	4%	9%	-	-			4	4	2%	2%
15	2	16	2%	14%	-	-			2	11	2%	9%	-	1		1%	2	2	2%	2%
16	5	16	1%	2%	-	1			3	10		1%	-	1			4	4	1%	1%
17	-	5		3%	-	8		4%	2	7	1%	4%	-	5		3%	1	3	1%	1%
18	-	-			1	5	1%	5%	-	2		2%	1	7	1%	6%	2	3	2%	3%
Total	**53**	**214**	**1%**	**2%**	**94**	**307**	**1%**	**2%**	**46**	**105**	**1%**	**2%**	**51**	**232**	**1%**	**2%**	**41**	**89**	**1%**	**2%**

Note: the above potentials are considered independently for each AWM option. There is therefore a possibility of double counting, i.e. the same rural household benefitting several AWM options. The total investment potential, areas and beneficiaries for the four options is likely to be less than the sum of the options taken separately

The maps are used to assess the potential number of beneficiaries and the extent of land which could benefit from any of the AWM solutions. These calculations represent a 'gross' potential and do not take into account demand-side aspects of agricultural production. Therefore a possible adoption rate is not applied. The calculations are performed as follows:

1. The total number of rural people falling into the areas of high or low suitability is calculated on the basis of a rural population density map. These results are then aggregated by livelihood zone
2. The description of the livelihood zones allows for the establishment of a factors that represents the part of the rural population which is likely to benefit from a given AMW solution. The factor reflects the importance of a given solution for the population living in the livelihood zone.
3. A unit area of land per household that can benefit from a given AWM solution is established on the basis of information obtained from the case studies and literature, i.e. 0.8 ha (pumps), 1.56 ha (soil and water conservation), 1 ha (river diversion), 1.5 ha (Dambos) and 1 ha (Small reservoirs). The number of potential beneficiaries, expressed in number of households, is then used to calculate the extent of land that could benefit from the solution. From national statistics, the country average household size is 4.8 persons.
4. The result is assessed against current extent of cropland in the suitable area, and in terms of its impact on the water balance, and adjusted downwards if needed.
5. The factors derived from sub-national statistics and livelihood mapping exercise (eg. farmers typology, livelihood typology, land holding size etc.) are applied as de-multiplying factors.

Quantifying the potential for investments in AWM

Tentative investment costs

Livelihood zones	Investment cost (Mln USD)									
	Low-cost motor pumps		River Diversion		*in-situ* water harvesting		Terracing		Terracing	
	min	max	min	max	min	max	min	max	min	max
1	0.0	3.6	1.1	1.1	0.2	0.8	10.6	15.4	1.0	1.4
2	0.3	1.8	1.2	1.4	0.6	1.5	26.7	30.0	0.1	0.3
3	0.1	0.4	0.1	0.2	-	0.1	35.4	12.1	1.8	2.2
4	2.5	9.6	0.1	1.7	7.8	12.0	11.2	24.8	22.2	34.7
5	-	3.0	-	0.6	0.1	0.4	0.8	11.7	12.0	16.1
6	-	2.0	-	-	0.2	2.8	-	-	12.2	12.2
7	1.1	2.2	-	-	0.4	1.6	-	-	2.9	2.9
8	2.1	3.5	-	-	0.2	0.6	-	-	1.6	1.6
9	0.5	3.0	0.1	1.1	3.2	5.5	5.0	33.7	3.0	16.2
10	0.3	0.9	2.6	3.1	0.0	0.1	28.2	33.4	0.2	1.3
11	10.9	23.9	3.8	14.7	4.6	5.8	133.0	333.0	14.3	130.2
12	4.1	24.5	-	4.5	-	0.4	0.8	117.3	41.4	84.6
13	0.0	1.5	-	0.0	-	0.6	-	4.2	4.3	4.4
14	1.0	8.3	-	-	6.3	13.1	-	-	16.8	16.8
15	0.9	8.2	-	0.0	1.2	6.5	88.4	0.1	9.9	10.0
16	2.4	8.2	-	0.1	1.7	5.7	81.2	54.5	16.5	17.6
17	0.1	2.5	-	0.8	1.5	4.1	147.1	24.4	4.7	11.6
18	-	-	0.1	0.5	-	1.3	-	18.3	9.0	12.5
Total	**26**	**107**	**9**	**30**	**28**	**63**	**568**	**713**	**174**	**377**

Investment costs

The following assumptions have been made to assess investment cost:

1. The average water amount required for irrigated agriculture is 7 500 m3/ha/yr
2. The potential area for application of AWM options should not exceed an extent which requires more than 30% of the country Internal Renewable Water Resources. For soil and water conservation practices this assumption is not considered.
3. 50% of adoption rate by suitable farmers due to market demand
4. For small pumps, the total investment cost is based on the number of households and not on the number of hectares
5. The investment costs only encompass the initial investment for infrastructure development and do not include the running costs and operation & maintenance costs.

Investment costs at country level		
AWM options	Unit cost	Investment costs (min-max)
		Million US$
Low-cost motor-pumps	400 US$/household	26 - 107
Soil&water conservation measures	300 US$/ha	9 - 30
Dambos (wetland rice)	600 US$/ha	28 - 63
Small Reservoirs	750 000 US$/m3 of water stored	562 - 713
River diversion	4250 US$/ha	174 - 377

For more information consult the project website **http://awm-solutions.iwmi.org**
or the FAO Water website **www.fao.org/nr/water/projects_agwatermanagement.html**
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