

# COUNTRY INVESTMENT BRIEF

Mapping and assessing the potential for investments in agricultural water management

**UNITED REPUBLIC  
OF TANZANIA**

## 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.

# Mapping the livelihood context

Different people in different places have different needs

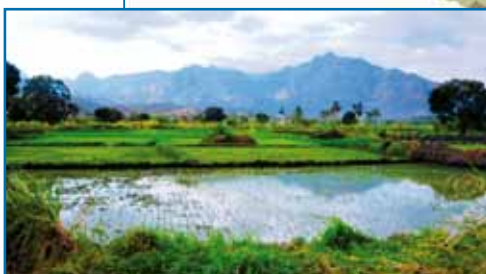
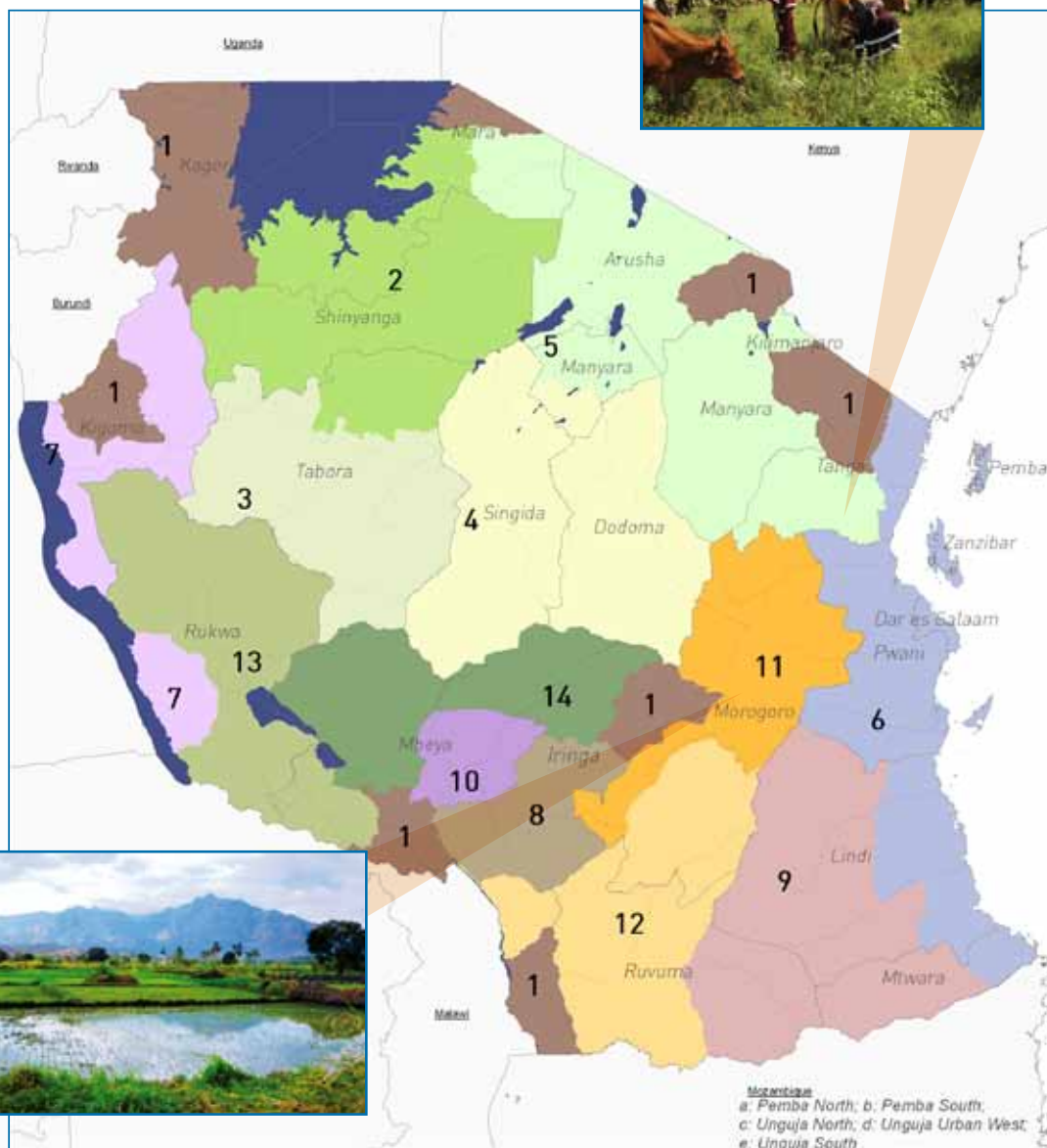
## The purpose of livelihood maps

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.

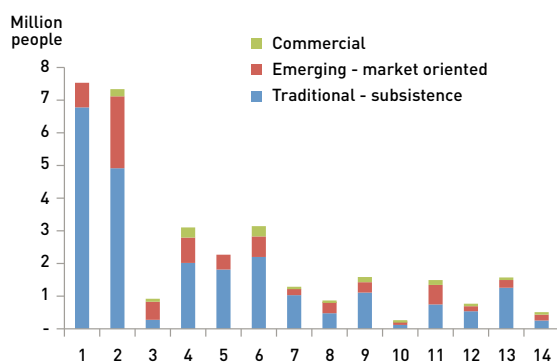
The map of livelihood zones is the result of a participatory mapping process involving a wide range of experts, professionals and farmers representatives. Each livelihood zone is described in details in terms of the main smallholders' livelihood strategies, dimensions of poverty, their water-related 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: Coffe-banana humid highlands        | 8: Tree plantations with crops-pyrethrum and tea |
| 2: Cotton-paddy rice-cattle midlands   | 9: Maize-cassava-cashew-simsim southern zone     |
| 3: Tobacco-cotton-miombo woodland zone | 10: Rice zone                                    |
| 4: Semiarid sorghum-livestock zone     | 11: Sisal-sugar cane - cattle zone               |
| 5: Pastoral zone                       | 12: Maize-tobacco southern highlands             |
| 6: Tree crops-fishing coastal zone     | 13: Rice-maize unimodal zone                     |
| 7: Lake Tanganyika zone                | 14: Rice-maize bimodal zone                      |

## 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

**Commercial farmers** These are large or small-scale commercial farmers and enterprises that are fully oriented towards internal and export markets

# Describing the livelihood context

from expert consultations

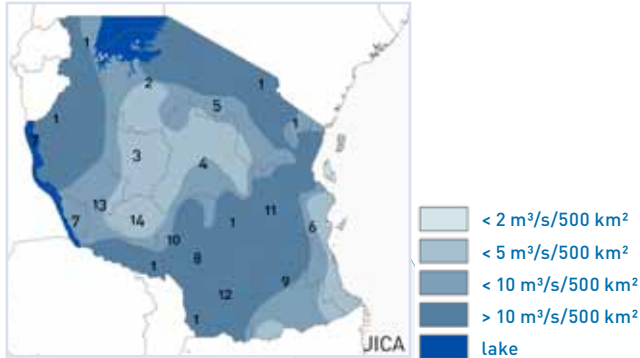
## Key characteristics of livelihood zones

Zone	Name – major production systems	Rural Population	Farmers typology	Main constraints for development	Water-related constraints and potential
1	Coffee-banana humid zone	7,531,890	Mostly traditional farmers (over 90%)	Soil fertility, low producers price	Water is plenty. Irrigation is not common. But exceptionally high in Moshi rural and Hai. Irrigation infrastructure can be improved to make agricultural production possible year round.
2	Cotton-paddy-cattle zone	7,337,450	Mostly traditional farmers (about 90%)	Erratic rainfalls, land scarcity, lack of technology	Water is the limiting to crops production in this zone and without water most other agricultural practices applied to crops do not result in significant increase in yield. Water for livestock is also a problem. Irrigation potential from lake victoria exist.
3	Tobacco-cotton zone	920,689	Mostly emergent farmers (60%), 30% traditional and 10 % commercial	Low rainfall, tsetse, poor accessibility	Water is very important for agricultural production. Irrigation potential of this zone is limited. There are no perennial rivers and no ground water aquifers with yields sufficient for more than a small area. Rainwater harvesting techniques is the only method used more extensively in irrigated agriculture in this zone.
4	Semiarid sorghum livestock zone	3,103,480	Mostly are traditional 90% and 10% emergent.	Irregular rainfall, tsetse, declining soil fertility	Though irrigation farming is not common in this zone, it's potentiality is high. It is desirable and feasible. Water harvesting techniques can be used.
5	Pastoral zone	2,269,120	Almost 80% are pastoralists. 20% are emergent farmers who combine crops with few livestock.	Dry lands, animal health, lack of watering facilities	This zone is not well endowed with large potential areas for irrigation. What exist are areas suitable for medium and small scale irrigation. Simanjiro district has the largest land under irrigation. Kiteto district has no potential areas suitable for irrigation. Spring, shallow wells ,gravity pump schemes, hand pump schemes are common.
6	Tree crops-fishing coastal zone	3,142,830	Almost 70% are traditional, 20% are emergent farmers and 10% are commercial farmers	Floods, lack of agricultural inputs, poor accessibility and processing facilities	Potential for irrigation farming is available through pangani, wami, ruvu and rufiji rivers. Presently there are several small scale irrigation schemes i.E. Matipwili, makurunge, mkoko etc.
7	Lake tanganyika fishing-maize zone	1,288,090	Almost 80% are traditional farmers, 15% emergent, and only 5% commercial	Poor accessibility, lack of agricultural inputs, animal health	Irrigation potential in this zone is very high although the prospects for irrigation using water reservoirs is still limited. It has been researched and confirmed that there is big irrigation potential in valleys of Luiche and Ruchugi.
8	Plantation zone (tea and pyrethrum)	867,995	Almost 60% are emergent farmers, 30% commercial and 10% traditional	Lack of agricultural inputs	Water availability for plantations is relatively good. Irrigation is not common in this zone, however , it is feasible considering the existing rivers, streams and artificial dams. Furrow irrigation is frequently used in mufindi areas. Localised rain flooding is used where topographical conditions create low lying, flat-bottomed basins.
9	Maize-cassava-cashew-simsim zone	1,585,670	70% traditional, 20% emergent, 10% commercial	Poor infrastructures, animal health	Land is plentiful, water is easily available. Water supplies is met mainly through multitude of shallow wells fitted with hand pumps. Rainwater harvesting is feasible. Ground water supplies are plentiful and favourable for installation of shallow wells. Numerous rivers and dams provide adequate supplies of suface water.
10	Rice zone	264,906	40% traditional, 40% emergent, 20% commercial	Farmer-herders conflicts, lack of technology	Traditional irrigation practice in usangu plains dates back to about 50 years ago. The potential irrigatable area is about quite high despite the limited area of the livelihood zone.
11	Sisal-sugarcane-cattle zone	1,492,810	40% traditional, 40% emergent, 20% commercial	Poor market development, accessibility, floods in rainy season	Being endowed with kilombero and wami river basins, then the irrigation potential in this zone is enormous. Mlegeni. The amount of rains which fall in this zone is also very encouraging.
12	Maize- tobacco zone	768,817	70% traditional, 20% emergent, 10% commercial	Poor infrastructures, soil fertility	Water accessibility not a problem, usually 400m from users
13	Maize-rice unimodal zone	1,572,330	80% traditional, 15% emergent, 5% commercial	Poor market development, accessibility, animal health	The zone has a good network of rivers. Most of them are perennial with fertile valleys. Very few of these are utilized during the dry season for irrigated farming.
14	Rice-maize unimodalzone	510,461	40% traditional, 40% emergent, 20% commercial	Farmer-herders conflicts, lack of technology	This zone has irrigation potential

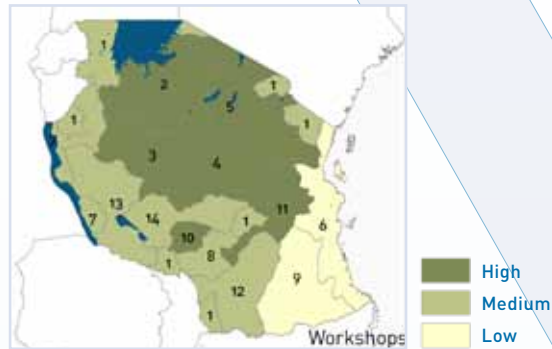
# Mapping potential and opportunities for water interventions

## Criteria used

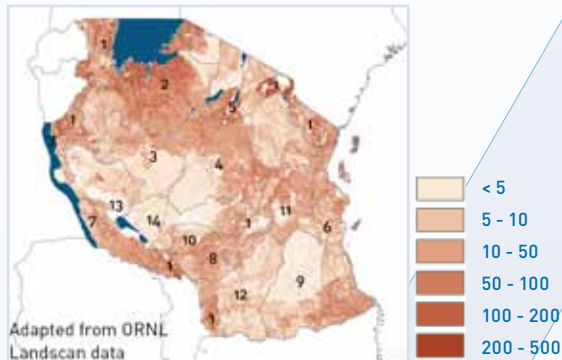
### 1. Water availability (runoff)



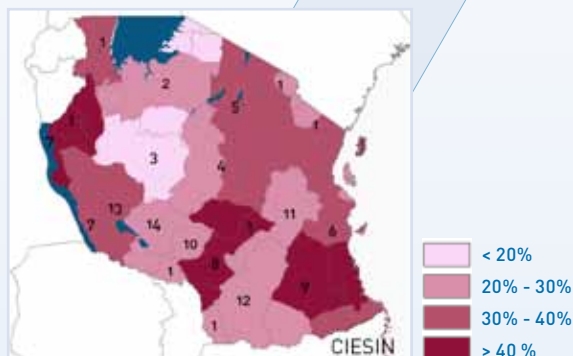
### 2. Perception of water as limiting factor for agricultural production



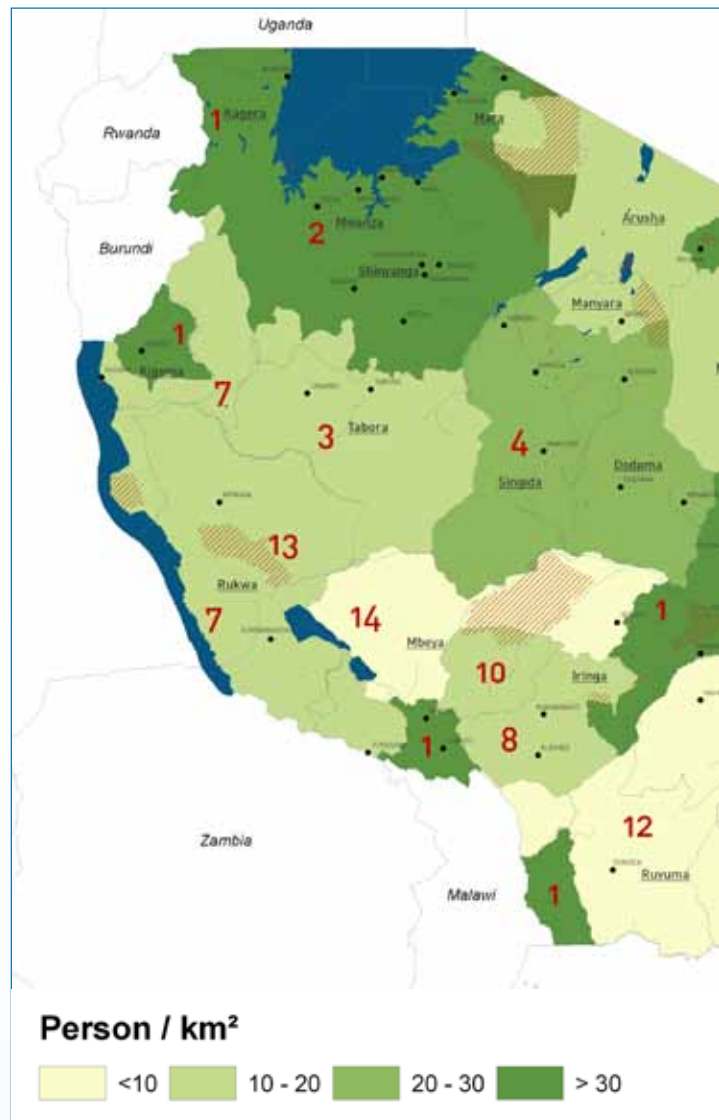
### 3. Rural population density



### 4. Poverty (underweight prevalence among children)

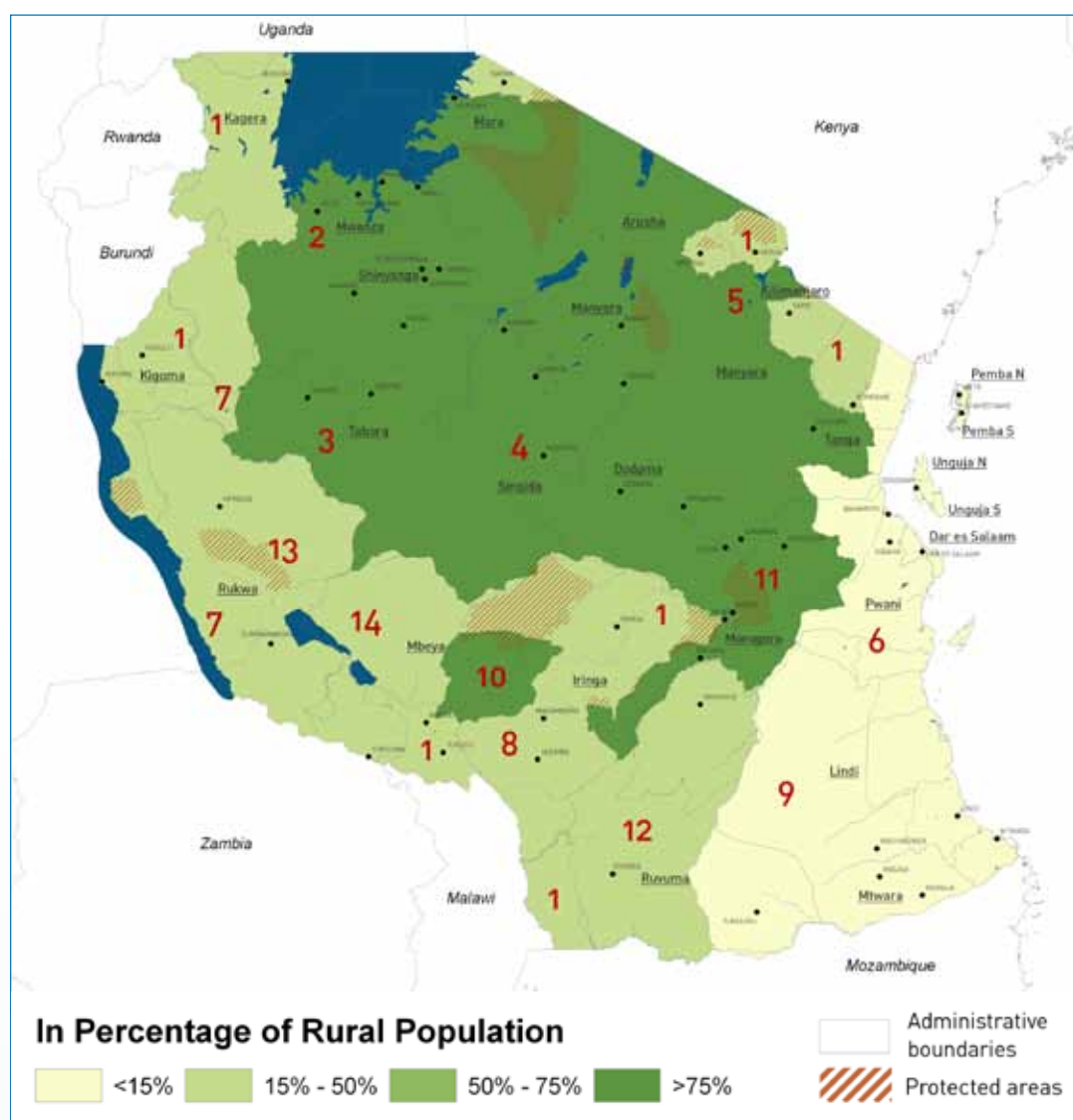


## Number of potential beneficiaries



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 below 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 above, 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 1700 m<sup>3</sup>/pers.). These maps are generic. The following pages show that the potential varies substantially as a function of the proposed technology.



No	Livelihood zone Name	Water availability: (m <sup>3</sup> /p/y)	Rural population			Perception of water as limiting factor for agricultural production	Potential beneficiaries	
			Total (,000)	Density (p/km <sup>2</sup> )	% poor (underweight)		Person (,000)	in % of rural population
1	Coffee-Banana Humid	1,958	7,532	75	36	Medium	3,766	50%
2	Cotton-Paddy-Cattle Zone	408	7,337	76	29	High	4,092	56%
3	Tobacco-Cotton Zone	3,798	921	16	20	High	737	80%
4	Semiarid Sorghum Livestock Zone	510	3,103	39	36	High	1,984	64%
5	Pastoral Zone	1,370	2,269	23	34	High	1,815	80%
6	Tree Crops-Fishing Coastal Zone	1,153	3,143	53	40	Low	471	15%
7	Lake Tanganyika fishing-maize Zone	4,099	1,288	31	40	Medium	644	50%
8	Plantation Zone (tea and pyrethrum)	> 6,000	868	35	54	Medium	434	50%
9	Maize-Cassava-Cashew-Simsim Zone	5,631	1,586	27	42	Low	238	15%
10	Rice Zone	4,830	265	21	24	High	212	80%
11	Sisal-Sugarcane-Cattle Zone	4,012	1,493	42	30	High	1,194	80%
12	Maize- Tobacco Zone	> 6,000	769	15	36	Medium	384	50%
13	Maize-Rice Unimodal Zone	5,616	1,572	26	26	Medium	786	50%
14	Rice-Maize Unimodal Zone	5,628	510	13	25	Medium	255	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 consultation 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. 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.

### 3. *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.

### 4. Terracing/bunds

Similarly to *in-situ* water harvesting, terracing (bunds) is farming technique to conserve rainwater in the soil and reduce water erosion that is practiced in steep areas. The practice implies the construction of on-farm earth terraces to facilitate water infiltration in the soil. This technique is very labor intensive and need necessary capital and training.

For the 4 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.

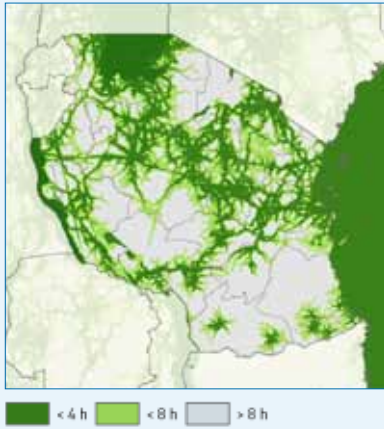
The resulting map shows distribution of these factors in the different livelihood zones which, in turn, identify areas where livelihoods conditions are more favourable for a given AWM solutions.



# Solution 1: Low-cost motor pumps

## Biophysical criteria and conditions

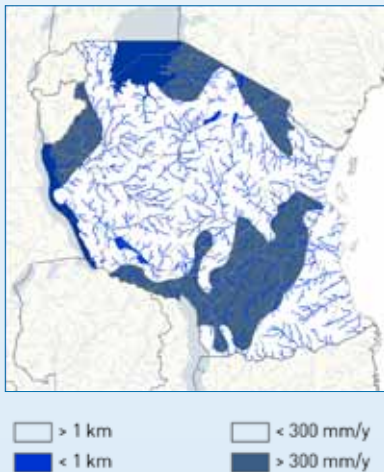
Market accessibility (h)



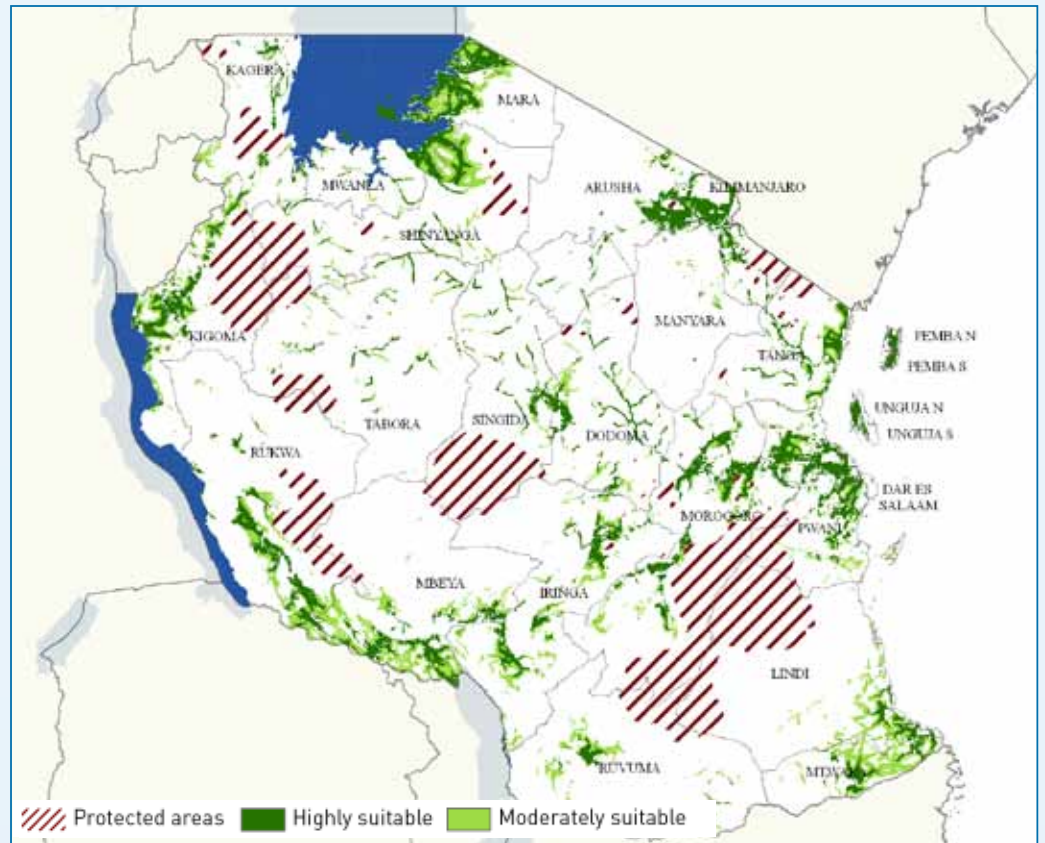
Shallow groundwater



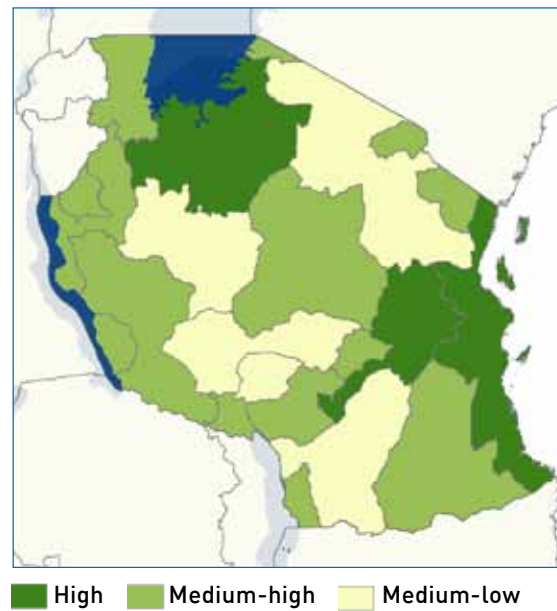
Distance to surface water + Runoff



## 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:

- **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** indicates relatively higher pressures on natural resources therefore the need for intensification which is associated to this technology

### Biophysical criteria and conditions

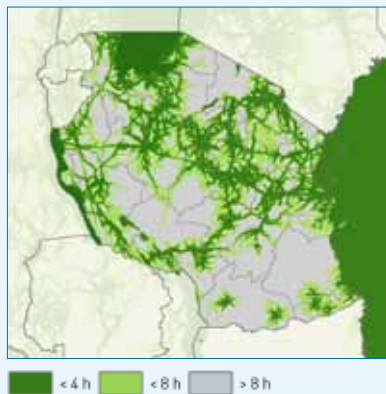
Market accessibility	Shallow groundwater	Surface water
<b>High:</b> cropland area < 4h from markets; <b>Moderate:</b> < 8h from markets	Requirement: presence of fluvisols/gleysols	Requirement: < 1 km from surface water OR runoff > 300 mm/yr

Physical suitability for low-cost motor 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: Community level river diversion schemes

## Biophysical criteria and conditions

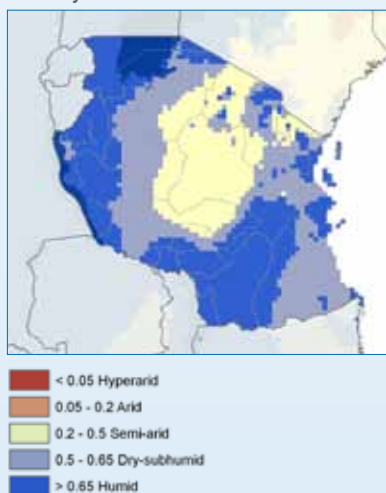
Market accessibility (h)



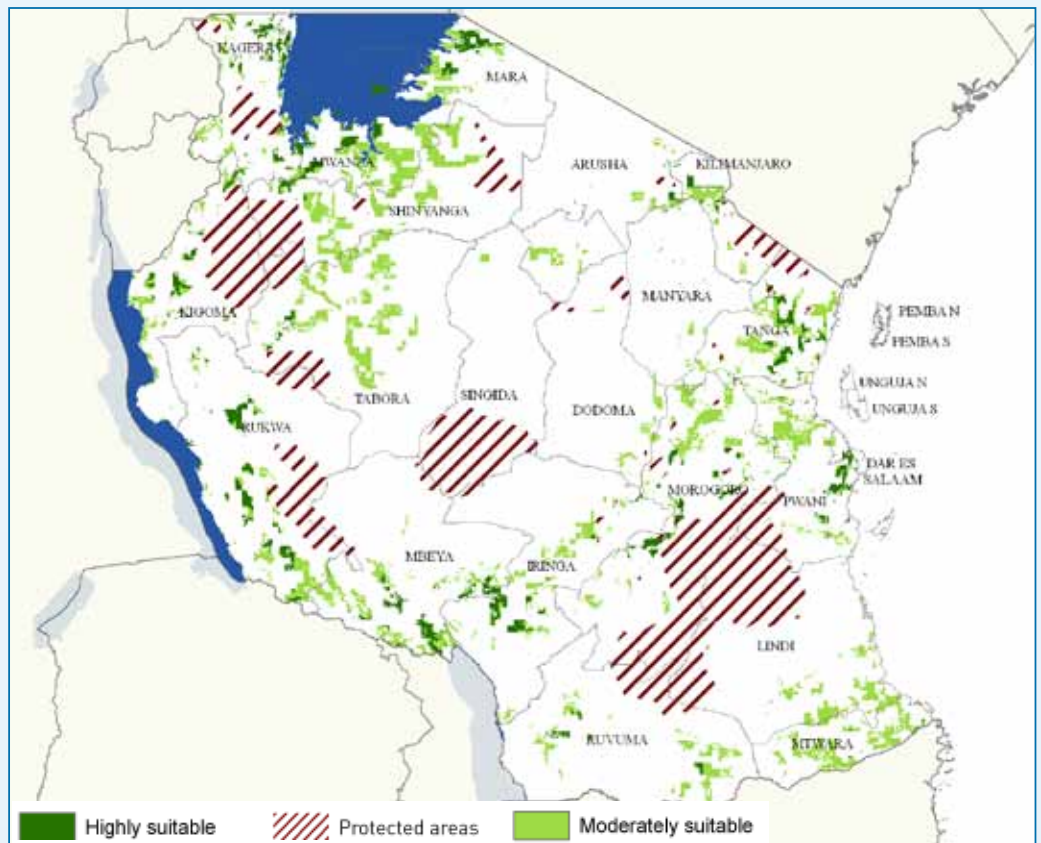
Distance to perennial rivers



Aridity Index P/ETref



## 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.

Biophysical criteria and conditions		
Market accessibility	Distance to perennial rivers	Aridity Index
<b>High:</b> cropland area < 4h from markets; <b>Moderate:</b> < 8h from markets	Requirement: < 1 km from perennial rivers	<b>High:</b> Dry-subhumid and Humid areas <b>Moderate:</b> Semi-arid areas

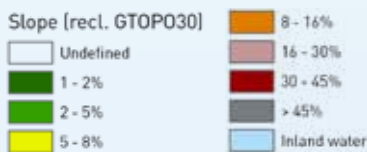
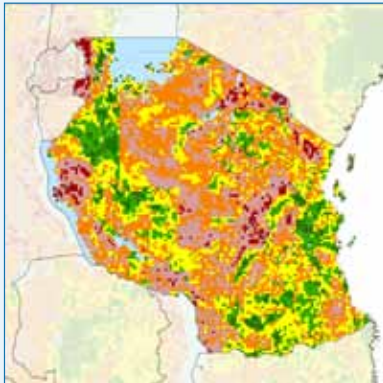
Physical suitability for river diversion has been assessed on the basis of: travel time to market (defined as centers of 20,000 inhabitants or more), with areas at 4 hours or less considered highly suitable and areas at more than 8 hours excluded, proximity to perennial rivers, and Aridity Index, with dry-subhumid and humid areas considered highly suitable and semi-arid areas moderately suitable.



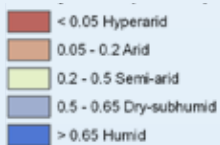
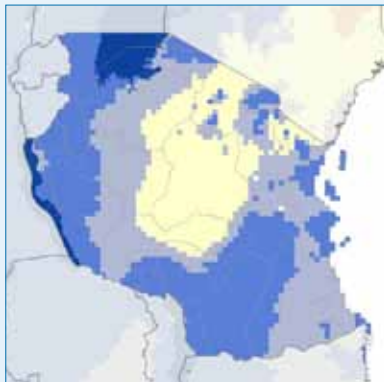
# Solution 3: *In-situ* water harvesting

## Biophysical criteria and conditions

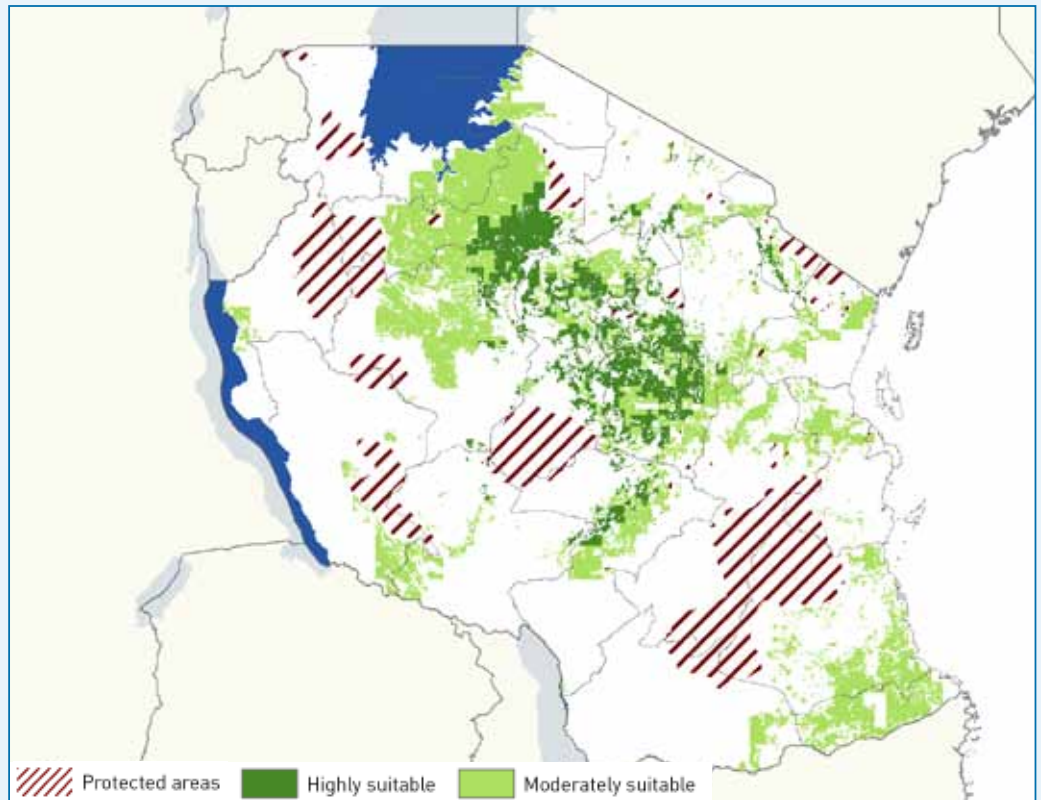
### Topography (slope)



### Aridity Index P/ETref

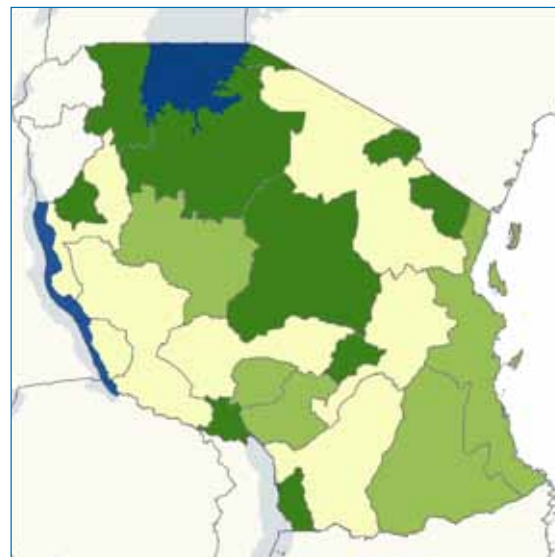


## Biophysical suitability



Protected areas Highly suitable Moderately suitable

## Livelihood-based demand



High Medium-high Medium-low

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 crops and reducing crop failure rather than increasing production for sale.

### Biophysical criteria and conditions

#### Aridity Index

**High:** Semi-arid areas;  
**Moderate:** Dry-subhumid areas

#### Topography

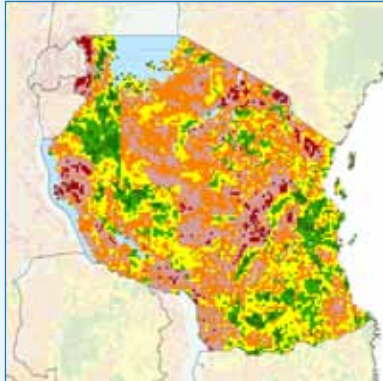
**High:** < 16% slope;  
**Moderate:** 16-45% slope

Physical suitability for *in-situ* water harvesting practices has been assessed on the basis of climate and terrain slope. *In-situ* water harvesting (increased soil moisture retention) is assumed to be suitable in semi-arid (higher suitability) to dry-subhumid areas (moderate suitability), and in nearly all slope classes, but preferably lower than 16%.

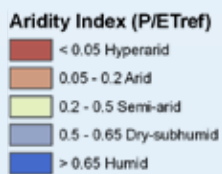
# Solution 4: Terracing (bunds)

## Biophysical criteria and conditions

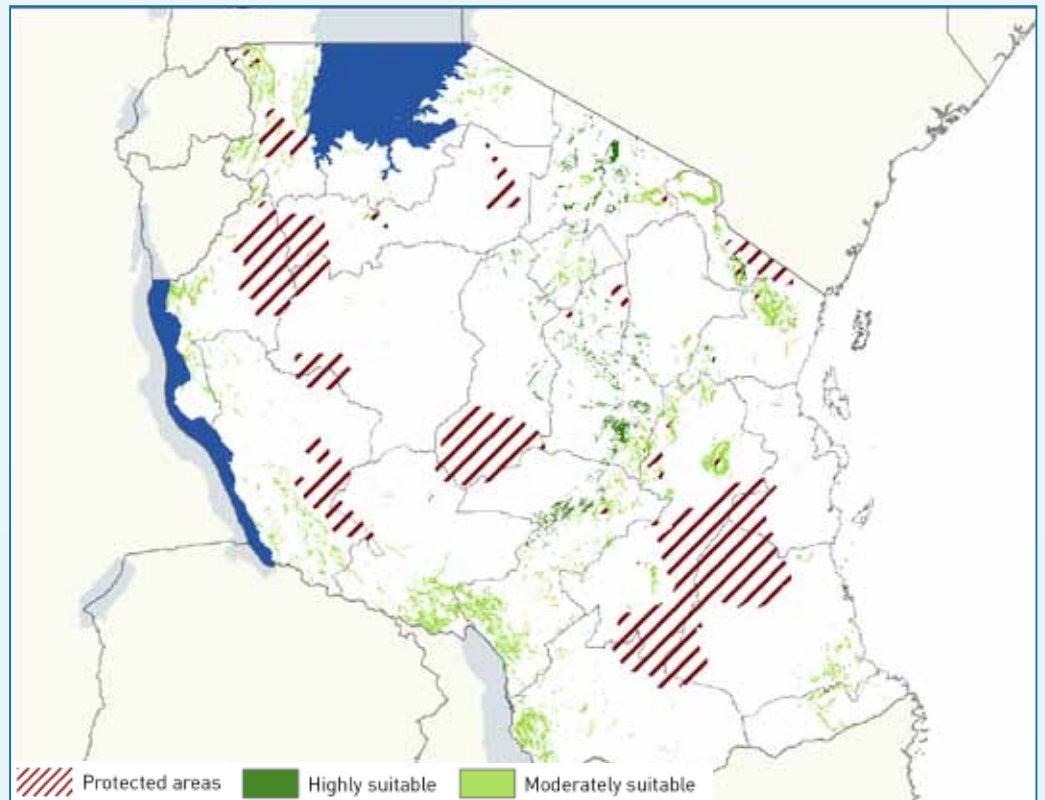
### Topography (slope)



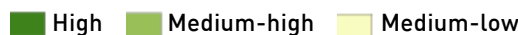
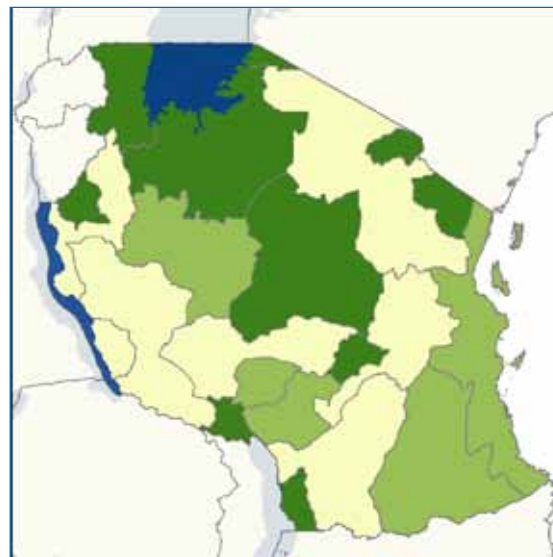
### Aridity Index P/ETref



## 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 crops and reducing crop failure rather than increasing production for sale.

### Biophysical criteria and conditions

#### Aridity Index

**High:** Semi-arid areas;  
**Moderate:** Dry-subhumid and Humid areas

#### Topography

**High:** > 10% slope;  
**Moderate:** 10-5% slope

Physical suitability for terracing (bunds) practices has been assessed on the basis of climate and terrain slope.

Terracing (bunds) is assumed to be suitable in slope classes higher than 5% and in all climatic conditions, but with preference given to semiarid areas.

# Quantifying the potential for investments in AWM

## Potential beneficiaries, application areas and investments costs

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

Livelihood zones	Low-cost motor pumps				River diversion				In-situ water harvesting				Terracing			
	[,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
1	196	260	13.5%	17.9%	67.8	140.9	4.7%	9.7%	8.12	110	0.6%	7.6%	2.3	215	0.2%	14.8%
2	106	164	7.5%	11.6%	38.3	161.4	2.7%	11.4%	94.5	602	6.7%	42.7%	0.1	8.59		0.6%
3	1.81	3.14	1.0%	1.8%	1.6	16.6	0.9%	9.4%	5.17	57	2.9%	32.2%	0.01	0.16		0.1%
4	20.9	28.4	3.5%	4.8%	0.0	4.8	0.0%	0.8%	183	290	30.6%	48.6%	12.3	17.8	2.1%	3.0%
5	9.21	13.8	2.1%	3.2%	3.6	15.1	0.8%	3.5%	14.1	67.4	3.2%	15.4%	4.2	14	1.0%	3.2%
6	97.2	129	16.1%	21.4%	10.5	44.3	1.7%	7.3%	0.47	90.5	0.1%	15.0%		4.55		0.8%
7	19	32	7.7%	12.9%	4.9	15.1	2.0%	6.1%		9.4		3.8%		12.6		5.1%
8	7.04	18.2	4.2%	10.9%	4.3	11.7	2.6%	7.0%	3.07	21.8	1.8%	13.0%	0.26	7.98	0.2%	4.8%
9	8.72	27	2.9%	8.9%	0.6	28.0	0.2%	9.2%		105		34.3%		4.45		1.5%
10	4.78	6.92	9.4%	13.6%	3.1	4.9	6.1%	9.5%	0.69	2.65	1.4%	5.2%	0.01	0.13		0.3%
11	31.3	40	10.9%	13.9%	7.4	29.4	2.6%	10.2%		31.7		11.0%		10.1		3.5%
12	3.33	8.45	2.3%	5.7%	1.6	4.6	1.1%	3.1%		0.15		0.1%		5.96		4.0%
13	25.4	45.7	8.4%	15.1%	9.6	28.2	3.2%	9.3%		38.6		12.8%		10.2		3.4%
14	2	4.16	2.0%	4.2%	0.1	3.8	0.1%	3.9%	8.13	20.9	8.3%	21.3%	1.76	2.38	1.8%	2.4%
<b>Total</b>	<b>532</b>	<b>781</b>	<b>8.5%</b>	<b>12.4%</b>	<b>153</b>	<b>509</b>	<b>2.4%</b>	<b>8.1%</b>	<b>317</b>	<b>1447</b>	<b>5.0%</b>	<b>23.0%</b>	<b>20.9</b>	<b>314</b>	<b>0.3%</b>	<b>5.0%</b>

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

Livelihood zones	Low-cost motor pumps				River diversion				In-situ water harvesting				Terracing			
	[,000 ha]		[% total agric. land]		[,000 ha]		[% total agric. land]		[,000 ha]		[% total agric. land]		[,000 ha]		[% total agric. land]	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
1	156	208	3.8%	5.1%	67.8	140.9	1.7%	3.5%	15.0	204.3	0.4%	5.0%	4.25	398	0.1%	9.8%
2	84.5	131	1.3%	2.1%	38.3	161.4	0.6%	2.6%	174.9	1114	2.8%	17.7%	0.18	15.9		0.3%
3	1.45	2.51	0.1%	0.1%	1.6	16.6	0.1%	1.0%	9.6	105.4	0.5%	6.0%	0.02	0.3		
4	16.7	22.7	0.4%	0.5%		4.8		0.1%	338.0	536.7	7.9%	12.5%	22.7	32.9	0.5%	0.8%
5	7.37	11	0.3%	0.5%	3.6	15.1	0.2%	0.7%	26.1	124.7	1.2%	5.6%	7.77	26	0.3%	1.2%
6	77.7	103	2.8%	3.7%	10.5	44.3	0.4%	1.6%	0.9	167.4		6.0%		8.42		0.3%
7	15.2	25.6	1.5%	2.5%	4.9	15.1	0.5%	1.5%	0.0	17.4		1.7%		23.3		2.3%
8	5.64	14.6	0.5%	1.2%	4.3	11.7	0.4%	1.0%	5.7	40.2	0.5%	3.3%	0.48	14.8		1.2%
9	6.97	21.6	0.3%	0.9%	0.6	28.0		1.2%	0.0	193.3		8.4%		8.23		0.4%
10	3.83	5.54	1.4%	2.0%	3.1	4.9	1.1%	1.8%	1.3	4.9	0.5%	1.8%	0.02	0.25		0.1%
11	25.1	32	2.1%	2.6%	7.4	29.4	0.6%	2.4%	0.0	58.7		4.8%		18.8		1.5%
12	2.66	6.76	0.2%	0.5%	1.6	4.6	0.1%	0.3%	0.0	0.3				11		0.7%
13	20.4	36.6	1.1%	2.1%	9.6	28.2	0.5%	1.6%	0.0	71.5		4.0%		18.8		1.1%
14	1.6	3.33	0.2%	0.4%	0.1	3.8		0.5%	15.0	38.7	1.9%	4.8%	3.25	4.4	0.4%	0.5%
<b>Total</b>	<b>426</b>	<b>625</b>	<b>1.4%</b>	<b>2.0%</b>	<b>153</b>	<b>509</b>	<b>0.5%</b>	<b>1.6%</b>	<b>586</b>	<b>2678</b>	<b>1.9%</b>	<b>8.5%</b>	<b>38.7</b>	<b>581</b>	<b>0.1%</b>	<b>1.8%</b>

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 market capacity aspects of agricultural production.

The calculations are performed as follows:

1. the total number of rural people found in 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 AWM 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 and river diversion), 1.85 ha (soil and water conservation). 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 5.2 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		<i>in-situ</i> water harvesting		Terracing	
	min	max	min	max	min	max	min	max
1	78.2	104	288.2	598.6	3	40.9	2.5	238.7
2	42.3	65.5	162.8	686	35	222.8	-	9.5
3	0.7	1.3	6.8	70.7	1.9	21.1	-	-
4	8.4	11.4	0	20.5	67.6	107.3	13.6	19.7
5	3.7	5.5	15.3	64	5.2	24.9	4.7	15.6
6	38.9	51.7	44.4	188.1	-	33.5	-	5.1
7	7.6	12.8	20.7	64	-	3.5	-	14
8	2.8	7.3	18.2	49.5	1.1	8	-	8.9
9	3.5	10.8	2.7	119	-	38.7	-	4.9
10	1.9	2.8	13.3	20.6	-	1	-	0.1
11	12.5	16	31.4	125	-	11.7	-	11.3
12	1.3	3.4	6.7	19.4	-	0.1	-	6.6
13	10.2	18.3	40.9	120	-	14.3	-	11.3
14	0.8	1.7	0.5	16.3	3	7.7	2	2.6
<b>Total</b>	<b>213</b>	<b>312</b>	<b>652</b>	<b>2 162</b>	<b>117</b>	<b>536</b>	<b>23</b>	<b>349</b>



### Investment costs

The following assumptions have been made to assess investment cost:

1. The average water amount required for irrigated agriculture is 7 500 m<sup>3</sup>/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	212 - 313
River diversion	4250 US\$/ha	652 - 2 162
<i>In-situ</i> water harvesting	300 US\$/ha	117 - 536
Terracing	600 US\$/ha	23 - 349

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](http://www.fao.org/nr/water/projects_agwatermanagement.html) and contact Guido Santini (Tel: +39 0657054400; E-mail: [guido.santini@fao.org](mailto:guido.santini@fao.org)) or Livia Peiser (Tel: +39 0657056421; E-mail: [livia.peiser@fao.org](mailto:livia.peiser@fao.org))