

African Water Revolution

Financing improved rainfed agriculture



Draft 1

Prepared by Len Abrams,
18 June 2018

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Working Paper for discussion at the
Expert Workshop on

***Answering the Call for an
African Water Revolution***

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Working draft intended for comment and input, not for broad circulation

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This document was initially prepared as a “Thought Leadership” piece as an input to a high-level summit meeting on the motivation for the establishment of the African Water Revolution and a Green Water Fund for Africa. It has therefore purposefully been prepared in a concise and accessible non-technical style.

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Cover image: Hand watering – Southeast Zambia
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1 The challenge

There has been a growing general awareness across Africa for a number of years that the prevailing situation facing the rural people of the continent, who make up nearly two thirds of the population, is becoming increasingly precarious.

The problems are complex and long-term. The difficulties experienced by rural populations in all countries of Africa do not only affect the rural areas, they impact the whole economy of all countries, because 2/3 of the human capital in each country is rendered largely unable to contribute to growth and development because they are trapped in a cycle of poverty.

1.1 The reasons behind the crisis

The reasons for the current situation are varied and complex. The reasons include both naturally occurring climate and geographical circumstances, and human driven factors.

Natural factors: Most of the rural population is employed in small-hold agriculture which is undertaken in harsh conditions with two particularly difficult and inter-related factors:

Land and water characteristics: Only a small proportion of cultivatable land (5.5 percent) is suitable for irrigation because of limited water availability and soil / topographical characteristics which means that most agricultural activity is rainfed (94.5 percent).

Climate variability and climate change: Most of Africa has limited and highly variable natural rainfall. The variability of rainfall is predicted to increase and annual average rainfall is likely to decrease in much of Africa as a result of climate change which will increase the vulnerability of rainfed agriculture.

Human driven factors: These can be attributed to on-farm issues and broader public policy issues.

Farming methods: Although there is increasing population pressure on the land, the proportion of cultivatable land which is being farmed is relatively small (27 percent) and only 1/3 of irrigable land is being irrigated (32 percent). The productivity of rainfed agriculture is also low with low crop yields (Maize: Africa- 1.82 t/ha; World av-5.11t/ha) due to poor farming methods including the impacts of land degradation, inefficient water usage, low fertilizer use, inadequate pest control, low mechanisation and poor support infrastructure.

Total land area in Africa (ha)	2,970,316,800
Cultivatable area	771,335,050
% of total land area which is cultivatable	26%
Irrigable area	42,504,370
Rainfed cultivatable area	728,830,680
% of cultivatable area which is irrigable	5.5%
% of cultivatable area which is rainfed	94.5%
Total land area currently under cultivation	210,673,190
Total area currently under irrigation	13,444,875
% of cultivatable area under cultivation	27%
% of irrigable area under irrigation	32%
% of area under cultivation which is irrigated	6.4%
% of total cultivatable area currently irrigated	1.7%

World population	7,632,819,000
% world rural population	44%
Africa population	1,287,920,518
Urban population	547,602,182
% Urban population	43%
Rural population	740,318,336
% Rural population	57%
Sub-Saharan Africa population	1,050,135,841
Urban population	423,958,015
% urban population	40%
Rural population	626,177,826
% rural population	60%

United Nations Population Division – Mid 2018

Public policy: The level of public expenditure in the rainfed agricultural sector is insufficient to underpin viable, productive and sustainable rural livelihoods, given the harshness of the natural conditions noted above. Low levels of public and private expenditure on infrastructure and services, institutional deficiencies, land tenure insecurity, lack of access to credit and extension services, regional conflicts and other factors all contribute to small holder farmers being forced into high-risk subsistence practices where they must largely fend for themselves.

1.2 The consequences of the crisis

The consequences of this crisis are critical and far-reaching, not just for the 740 million rural people of Africa, but for the continent as a whole.

Food shortages and malnutrition: The FAO reports that nearly a quarter of the population in Sub-Saharan Africa (SSA)¹ (22.7 percent) are undernourished (224 million people), with 31 percent of the population experiencing food insecurity². Food shortages and malnutrition result in stunted growth and permanent damage to the population which has long-term impacts.

Expensive food imports: On a continental level, Africa is not feeding itself. Net food imports to Africa are costing on average USD35 - USD42 billion / year and are predicted to reach USD110 billion by 2025. *“Africa’s annual food import bill weakens African economies, decimates its agriculture and exports jobs from the continent”* (President of the African Development Bank (AfDB), Akinwumi Adesina. 2017). This food bill does not represent investment – these are sunk costs. In comparison, the African Development Bank has pledged to invest USD2.4 billion annually in African agriculture over ten years. The sunk costs of food imports, in addition to distorting African food production, are greater than the estimated costs of investing in improved rainfed agriculture (see below).

Land degradation: Land degradation results in reduction in the productive capacity of land due to wind and water erosion of soil, loss of soil humus, depletion of soil nutrients, and the loss and deterioration of vegetation cover. This in turn further reduces agricultural output and increases poverty, forcing people into short-term coping strategies such as charcoaling and deforestation. In a recent study of the Zambezi River basin which is shared by eight countries³, it was determined that 51 percent of land is moderately degraded and 14 percent is highly degraded. This leads to high sediment loads in rivers and the silting up of

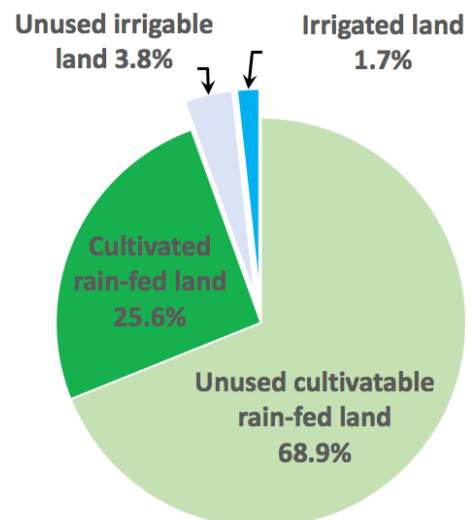


Figure 1: Types and utilisation of cultivatable land in Africa

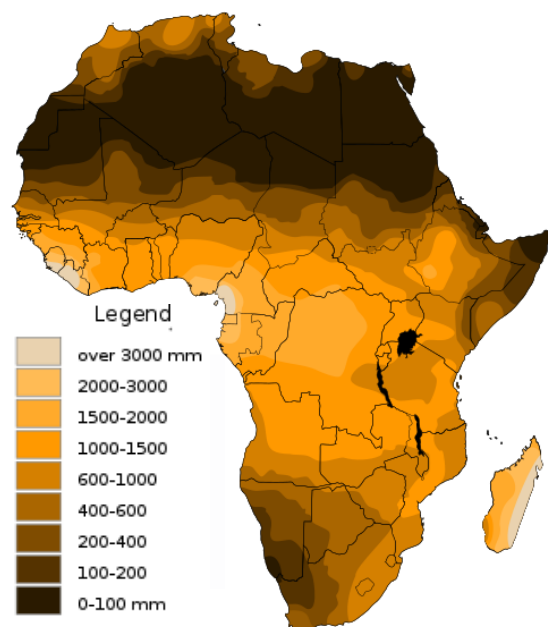


Figure 2: African precipitation [Delphi234 (Africa Precipitation Map-sr.svg)]

¹ Note: The intention of the African Water Revolution is to include the whole of the African continent. However much of the data has been derived at sub-continental level covering either Sub-Saharan Africa or the MENA Region.

² Regional Overview of food security and nutrition-FAO-2017

³ Angola, Botswana, Namibia, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe.

water courses and dams, undermining investments in large scale water storage, especially for irrigation and hydropower production.

Macro level 'drag' on national economies: The primary consequence of widespread rural poverty across Africa is downward pressure into ever deeper and more intractable rural poverty which has inescapable economy-wide impacts. This is primarily because each country is deprived of two thirds of its potential human capital which, instead of working in skilled employment as teachers, business people, health professionals, traders, productive farmers, etc. are trapped in an uncertain existence living off increasingly infertile land.

1.3 Responses to the crisis

African leaders and governments are aware of this dual crisis – widespread, deep rural poverty and increasing food insecurity. This is evidenced by the commitments of the African Union Heads of State, for example in the endorsement of the Comprehensive Africa Agriculture Development Programme (CAADP) as a programme of the New Partnership for Africa's Development (NEPAD).

Growing awareness of the crisis is also evident from the various programmes and projects targeting rural agricultural development which the multi-lateral and bi-lateral development agencies, development banks and United Nations agencies have initiated.

The focus, however, of much of private and public investments in agriculture has been on commercial irrigated schemes and the 'industrialisation' of agriculture. Much of this is directed towards non-food, export targeted output which, whilst generally contributing to improving Africa's balance of payments in international trade and to a degree thereby contributing towards food security, does not improve African food self-sufficiency nor address rural poverty. With about 60 percent of the world's uncultivated arable land situated in Africa, there are concerns that substantial Foreign Direct Investment (FDI) in African agriculture is aimed more at meeting the strategic food interests of the investing countries than in meeting Africa's needs, whilst in many cases alienating local people from their land.

There is a growing awareness that the approach adopted over the past few decades, as summarised above, is not solving the crisis - the bill for food imports is increasing, rural poverty continues to deepen and the impacts of climate change create further uncertainties. It is becoming increasingly clear that new approaches need to be adopted, aimed at supporting and transforming the rural economy.

This needs to be multifaceted, based on the fact that if Africa is going to feed itself and reverse poverty, the answer lies in supporting smallholder and communal dry-land, rainfed agriculture at large scale.

If five decades of largely unsuccessful attempts at rural development has illustrated anything, it is that there is no single 'silver bullet' – it is very complex and requires a range of different pieces of the puzzle to be in place – functional governance and administrative structures at all levels down to the village and farmstead; transport and marketing infrastructure; finance and credit; training and agricultural extension services; and, critically, **water!**

Subsistence agriculture

A type of farming in which most of the produce is consumed by the farmer and his/her family, leaving little or nothing to be marketed and only allowing for a marginal livelihood. This is a type of farming, not a type of farmer. Farmers engage in subsistence agriculture by force of circumstance and will produce a surplus wherever possible to provide income.

2 Green Water – the hidden key

Water can be divided into different types which broadly describe where it is found and which ways it can be utilised. With respect to African development, there are two main types of water which are of interest – Blue water and Green water.

'Blue' water is described as the water in rivers, lakes, dams, wet lands and aquifers. This is the water with which we are conventionally aware of. 'Blue' water is all initially derived from rain water runoff. Across Africa most 'blue' water is found in large transboundary river basins which are shared between two or more countries. All conventional water resources management and development for direct human consumption, irrigation, hydropower generation, industry and urban development is 'blue' water, including groundwater sources.

A characteristic of the arid and semi-arid areas of Africa, due to rainfall (less than 500mm/year), topography and surface conditions, is that only 10-25 percent of rainfall contributes to runoff and hence augments 'blue' water supplies. 75-90 percent of rainwater infiltrates into the soil from where it can percolate deeper into groundwater,

'Green' water is water derived from rainfall which is available in the soil for plant growth through evapotranspiration. However, not all the water which infiltrates into the soil is used for evapotranspiration and plant growth – a proportion will return to the atmosphere as evaporation. Crops generally use less than 30 percent of rainfall in semi-arid regions – up to half the rain evaporates directly from the soil and the remainder runs off the surface or seeps into the groundwater.

Green Water
Soil moisture from infiltrated rainfall available for uptake by plants.

Blue Water
Rain water run-off occurring in streams, rivers, wet-lands, dams, lakes and aquifers.

Grey water
Waste water from domestic or commercial sources (not contaminated by toxic pollutants).

Black water
Water contaminated by organic or inorganic pollutants, especially faecal matter.

Rainfall		100%
Blue water	Runoff	10-25%
	Infiltration to Groundwater	10-30%
Green water	Evaporation	30-50%
	Transpiration	15-30%

The key to rainfed agriculture is to maximise the water available to support plant growth (maximise evapotranspiration), and to make the most efficient and productive use of water through improved plant varieties, increasing soil nutrients (fertilizer use) and pest control.

There are critical points in the growth cycle of crops where plants need moisture – brief dry spells in the growing season may result in significantly reduced yields, even when the overall seasonal rainfall may be sufficient. Capturing and maintaining soil moisture to be available when the plants most needs it is key to productive rainfed agriculture.

The two key elements of increasing green water availability for plant growth are green water capture and green water storage. Water capture increases the availability of green water through reducing rainwater runoff and groundwater seepage, and water storage increases the green water available for plant transpiration through reducing evaporation. Rainwater capture or harvesting can be done in a variety of ways including terracing, ponding, and the use of small dams. Soil moisture storage can be achieved through avoiding ploughing using conservation tillage methods, and through mulching, intercropping, windbreaks, and other methods.

None of this is new - many of the methods and technologies have been available for decades both from the scientific / engineering community at large, and through customary agricultural practice. It is not 'alternative technology' reserved for use only by the rural poor thus condemning them to perpetual subsistence – it is based on well-established scientific findings which have been proved in practice throughout the world.

As noted above and discussed further below, regenerating the rural economies of Africa is a complex process which will take time. It will require a multi-faceted approach involving governance, markets, transport etc., but none of these will be to any purpose unless water is available and, given that 95 percent of cultivatable land and agricultural activity is rainfed, green water is the primary option. Whilst all the other pieces of the puzzle are necessary, the African Water Revolution focuses on green water, which, together with the other elements, will herald a new era for Africa.

Table 1: Typology of Agricultural Water Management Systems

Agricultural water management type	Agricultural water management system	Main technologies
Improved water management in a rainfed environment	1. Pure rainfed cropped area	Managing soil moisture
	2. Improved rainfed	Small-scale water harvesting
Small Scale Irrigation (individual, community-based)	3. Individual low-cost irrigation	Pump irrigation, both manual and motorized
	4. Community-based irrigation	Low-cost diversion, flood recession, communal pump schemes
Large-scale public irrigation	5. Large-scale irrigation	Dams or weirs; surface canals; furrow irrigation
Large farmer irrigation and PPP	6. Private commercial irrigation	Dams or weirs; surface canals; furrow irrigation
	7. Market-oriented irrigation on a PPP basis	Piped irrigation; drip, sprinkler; protected (greenhouse) agriculture

Note: PPP = public-private partnership – (Ward, Torquebiau and Xie, World Bank, 2016)

3 Investing in Green Water

3.1 Understanding the potential of rainfed agriculture

A recent World Bank study entitled 'Improved Agricultural Water Management for Africa's Drylands'⁴, makes the case for investing in irrigation in Africa's Drylands. The study, which draws on the work of IFPRI (International Food Policy Research Institute) notes the limited potential for large scale 'blue' water investments in irrigation (1.27 percent of cultivable area in dry-land zones) which concurs with the information provided above. In addition, the study identifies the potential for small scale irrigation undertaken at an individual farmer and communal level. This is also only possible on a limited scale due to availability of water in the dryland zones (7.20 percent of cultivable area). Both large and small scale irrigation are promoted as potentially profitable enterprises with reasonable Internal Rates of Return (IRR) of 5-12 percent. The World Bank study provides estimates of the cost per hectare of developing large and small scale irrigation, and the cost of rainfed green water management, together with estimated yields (see Table 2).

⁴ Ward, Torquebiau and Xie, World Bank, 2016

Table 2: Development potential in dryland zones in Sub-Saharan Africa

Agricultural water management type	Cost / ha	Production /ha	Cost/kg	Potential area* ha	Production	Investment cost	Water type
Improved water management in a rainfed farming	\$250	1t**	\$0.25	126,000,000	126 Mt	\$31.5 billion	Green Water
Small-scale irrigation (individual, community-based)	\$4,500	2t	\$2.25	9,075,000	22.7 Mt	\$40.5 billion	Intermediate
Large-scale public & private commercial irrigation	\$12,000***	8t	\$1.5	1,601,000	12.8 Mt	\$19 billion	Blue Water

* Potential cultivatable areas within the climatic zones defined as 'drylands' from HarvestChoice, IFPRI (2013)

** Chosen as an average estimate – yields are 400-1,500kg/ha with 400-500kg/ha attributed to improved soil moisture

*** Note that this excludes the cost of water storage in dams and the cost of water transfer to the irrigation schemes (Ward, Torquebiau and Xie, World Bank, 2016)

A number of important observations can be made from the World Bank / IFPRI and other studies.

- Production in the remaining 92.5 percent of the dryland cultivable area depends solely on rainfed soil moisture.
- The estimated cost of green water management in rainfed small-holder farming is USD 50 – USD 250 per hectare. This is the cost of small-scale rainwater harvesting and in-field soil moisture retention techniques and is largely low-technology and labour intensive.
- The estimated yield per hectare is deliberately quoted conservatively at 1 ton for rainfed African cereal yields. The yields would be increased through non-water activities such as fertilising and pest control. The key, however, is resilience and risk reduction – ensuring that soil moisture is available so that even modest yields are achievable, particularly in dry spells, and that the benefits of inputs such as fertiliser will be realised.
- Even quoting conservative yield figures and using the higher end of the cost estimate, the yield per USD1000 of investment is 4 tons in improved rainfed farming, 0.44 tons/USD1000 for small scale irrigation and 0.67 tons/USD1000 in large scale irrigation.
- Although the yield of commercial high-tech large scale irrigation is some 8 times per hectare that of rainfed yields, the constraints in Africa on the area which can be irrigated means that irrigation alone can only meet a fraction of Africa's food needs, especially as a large proportion of the outputs produced do not contribute to the staple food needs of Africa. **Commercial large scale irrigation is not a solution to rural poverty in Africa as it only directly benefits a very small relative number of people. Commercial large scale irrigation should certainly be undertaken wherever it is possible but should be self-financed on its own commercial merits.**
- Small scale irrigation by individuals and at community level has significant potential for food production but it is also limited in possible extent (7.2 percent of cultivable area in dryland zones). Extensive small scale irrigation would have an impact on rural poverty as it could provide direct benefits to an estimated 60 million people (World Bank 2016).

Box 1: The case for including small scale irrigation, small dams & other small sources under 'Green Water'.

For the purposes of the African Water Revolution, small scale irrigation supplied by small dams and other water harvesting techniques are regarded as part of green water management where it is combined with in-field green water conservation techniques and is used by smallholder farmers to augment rainfed agriculture. Small scale irrigation is only possible in limited areas – 7.2 percent of cultivable area in dryland zones.

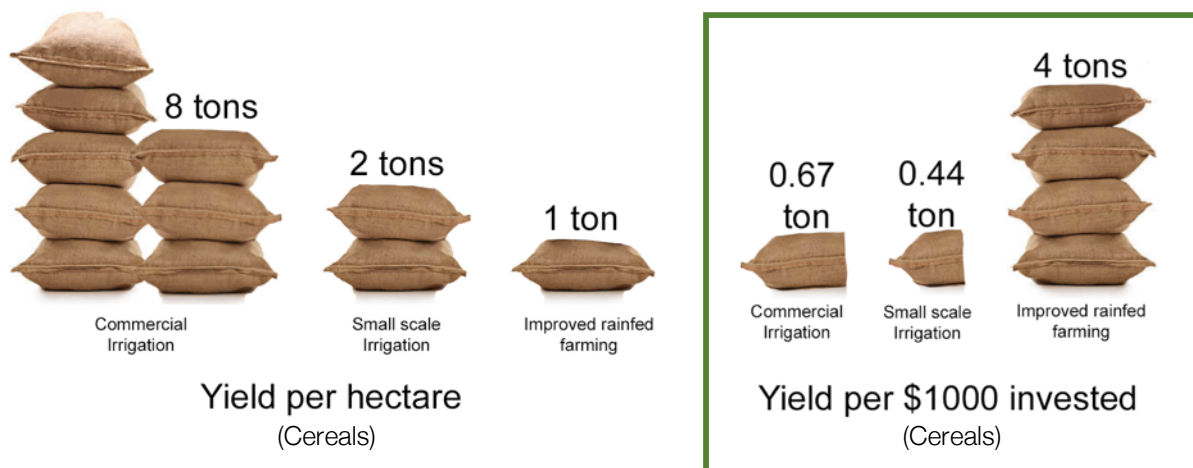


Figure 3: Yield comparisons
(Source: author, 2018)

3.2 Supporting improved rainfed agriculture

The highest potential for improved food production and poverty reduction lies with improved rainfed farming, enabled through green water management in the vast rainfed cultivable tracts of Africa. Because yields are generally currently very low, the potential for improving productivity is highest in rainfed agriculture, principally through managing green water.

The yield per dollar invested in improved rainfed agriculture is potentially 9 times that of small scale irrigation and 6 times that of large scale irrigation and the land available is virtually limitless if it is recovered and restored from the degradation caused largely by poverty. A 1 percent increase in productivity in rainfed agriculture would be equivalent to a 10 percent increase in irrigated agriculture in Africa.

At a macro level, in considering the Dryland zones of Sub-Saharan Africa, the following estimates illustrate the potential investments required and the possible yields. (World Bank, 2016)

Large scale commercial irrigation	– \$19 billion	– 18 million tons
Small scale irrigation	– \$40.5 billion	– 22.7 million tons
Improved rainfed agriculture	– \$31.5 billion	– 126 million tons
(Annual food import bill)	– \$35 to \$42 billion	sunk cost each year

Given that it is evident that there is a strong case for investing in improved rainfed agriculture through the management of green water, the question arises as to how this can be done **at scale** which will contribute to the regeneration of rural economies across Africa, increase African food security and contribute to African growth and development as a whole.

4 Making Green Water work for Africa

4.1 Putting the Farmer First

For the estimated 740 million people who make up the rural population of Africa, most of whom are engaged in smallholder rainfed agriculture which provides 90 percent of Africa's food, life is a matter of continually managing risk. Given that the only option which they have of increasing their

resilience (in terms of water) is to adopt green water techniques, how can they be supported in doing this farm-by-farm, at a scale which will ultimately make a difference at continental level?

One of the overarching lessons of rural development across Africa over several decades, learned by governments, development agencies, financiers, NGOs and civil society, is that it is only successful when individuals, families and communities are placed at the centre of their own development. When they are empowered and supported to make their own decisions which impact directly on their own wellbeing, the results are far more likely to be sustainable and replicable at scale than when development is 'done to them'.

There are individual anecdotal examples of communities which have successfully achieved a level of resilience in very difficult circumstances with different types of green water schemes, and there

Box 2: The Small-holder farmer.

The context is one of continual uncertainty, related mainly to whether or not the rains will come, when they come, and in what form – torrential downpours causing floods, or rains spread out over the growing season when the crops need the water most. The greater the uncertainty and the fewer your resources (based often on what happened last season) the greater the risk and the fewer your options.

You become increasingly risk averse because the consequences of failure become increasingly severe – starvation and total destitution for you and your family is always a stark possibility. Introduction to anything new will be very carefully weighed up in terms of cost, effort, risk and possible benefit. Will the benefits be lasting and repeatable? What are the implications if it does not work – will I be worse off than if I had not tried it? Show me – I need to be convinced that it will work before I can take the chance. Whilst this may be undertaken and advised from the outside with the best of intentions, it is me and my family who will live with the consequences.

Box 3: Small dams in Matabeleland South, Zimbabwe

The Matope and Mabate Dams and irrigation schemes were constructed in 1999 in Matabeleland South in Zimbabwe as part of a scheme undertaken jointly by communities, a consortium of NGOs and Rural District Councils in response to the devastating droughts of 1992. The "Give a Dam" programme put communities at the centre of the process. The schemes are community gravity fed irrigation schemes fed by small dams. Matope scheme serves 150 families in 3 villages and Mabate scheme is worked by 21 families.

When the Zimbabwean economy collapsed in 2008 all support activities from outside the schemes stopped. However, when visited five years later in 2013, both schemes were fully and very productively functional although it was clear that maintenance was needed on the dams (spillways, encroaching vegetation, siltation etc.).



Matope dam irrigation scheme



Mabate dam drip irrigation

The Committees in both schemes indicated that local self-governance through a clear Constitution which set out how the schemes are operated and how plots are allocated etc. is a key factor of their success.

The dams provided water for small scale irrigation and stock watering – there were indications of tension between these two groups.

The dams provide sufficient water for a single crop each year. The committees estimated that the irrigation schemes provide for direct consumption needs for six months each year and the equivalent of the value of 3 goats cash income per family each year which approximates to USD120 per year. (Since the days of hyper-inflation in Zimbabwe, community members measure wealth in livestock equivalents!) The communities consider themselves to be very fortunate to have access to these modest assets compared to surrounding communities who are not as fortunate.

*(Source: Author – as part of CRIDF, 2013
Images: © Len Abrams, 2018)*

situation in African dryland zones – then they become trapped in a necessarily risk averse subsistence state which in some years will result in failed crops and them being unable to feed themselves, and in all other years producing average yields. In seasons with average and good rains they will not be able to take advantage of greater potential yields because they could not risk the costs of inputs such as fertiliser, not knowing beforehand what the rainy season would be like.

The first step in transforming this situation and building sustainable livelihoods is ensuring that, at the very least, farmers do not fall below the “Subsistence Point” (Figure 4.) through securing green water which will be available in all but the most persistent droughts. This should not be regarded as a strategy which will condemn such farmers to perpetual subsistence states – removing the risk of failed subsistence from the farmer is a major step forward which would enable the farmer to have increasing latitude in investing in inputs which will enable them to take advantage of average and above average rainfall and thereby begin to build their livelihoods and wealth. It has the effect of removing uncertainty and increasing sustainability – replacing the vicious cycle of increasing poverty with the virtuous cycle of increasing wellbeing.

It must be stressed that this is only meant to be the first step – further processes would be required to further increase improved rainfed agriculture but the highest potential for individual farmers and for food production in Africa as a whole is to get as many farmers as possible to the first stage of basic water security where they are able to confidently meet their own needs in bad years and begin to produce excess outputs in good years.

This will not only have an impact on those directly involved in farming but will also provide the basis for other economic activities in the rural areas as demands increase for agricultural inputs and markets develop as a result of increased outputs. This in turn will drive other commercial activities not directly related to the agricultural value chain.

4.3 Taking the long view

A feature of much of development in recent decades has been the setting of targets and goals which is necessary to create focus and to provide a basis for measuring progress (for example the Sustainable Development Goals). However, the goals are often more reflective of the politics of conferences, summits and donor sponsored events than of the harsh realities affecting millions of people and the ebb and flow of people, climate and land. The potential incremental progress of the many is put at risk in the interests of high profile gains which often benefit only a few.

Progress in turning African rural economies around and in enabling science and tradition to mutually ensure greater productivity will take time, leadership and commitment. The current crisis has been developing for decades, it will not be resolved quickly. A long strategic view is needed which will be generational in timeframe (20-30 years) and carefully constructed on sound institutional, technical and economic grounds. This is not to say that support should not be made available as quickly as possible given the needs of two thirds of the population, but the problems will not be resolved merely by making funds available because some elements of the problem are undoubtedly systemic and structural.

A generational incremental approach would focus initially on adopting a ‘some for all’ approach to ensure that as many farmers as possible in rainfed zones at least meet the basic needs of their families and communities without the need for external feeding support – see Figure 4. Thereafter the emphasis would shift towards increasing efficiency and productivity to move beyond subsistence to income generation in order to build viable rural economies, thus enabling the human capital of the rural population to contribute to building national economies. Achieving this vision of rural regeneration would likely need to start in targeted programmes in a small number of initial countries which could act as champions to encourage others.

4.4 A Multi-faceted challenge

The vision of the possible impact of improved rainfed agriculture across Africa expressed above is only possible if water is available at farm field level and that is only possible through green water capture and use. However, whilst the African Water Revolution is the focus of this initiative and this paper, water is only one (essential) piece of the puzzle and would need a number of other factors to be in place in order to succeed. The factors which need to be addressed for improved rainfed to succeed include:

- An actively supportive political context;
- The full engagement of the public sector
 - The commitment of public expenditure;
 - Supportive public institutional structures at all levels;
 - A multi-sectoral approach involving agriculture, water, land and rural development sectors;
 - A supportive policy and regulatory context;
- Broad public awareness and support, particularly in rural areas;
- An inclusive context involving a wide range of stakeholders; and
- The engagement of external support.



Figure:5 Rainwater harvesting - a sand dam in Gwanda district, Zimbabwe

(Source: Dabane Trust © 2018)

4.4.1 Active political support

Focused political commitment is needed to support rural regeneration and thereby transform local rural economies through incremental improvements in rainfed agriculture. There is a need to counter political scepticism regarding the merits of investing in rural subsistence agriculture and overcome the inertia of public institutions to embrace change. Political leadership is needed to change institutional cultures which have largely favoured the financing of high profile blue water investments which, as noted above, will not resolve the food security crisis of Africa and will benefit a relatively small number of people. Instead, political leadership at the highest level should clearly mandate the public sector to prioritise improved rainfed agriculture at large scale. One approach to overcoming scepticism and inertia is to identify a

small number of champions at the highest political level to commit to large scale rural regeneration projects in their countries which will act as catalysts for the take up of the approach more broadly across Africa.

There is a considerable and growing emphasis on addressing the food crisis in Africa and on developing commercial agriculture within the African Union. This generally however tends to be largely in terms of producing high value export-oriented agro-industrial outputs aimed at decreasing balance of payment deficits. In some quarters there is specific resistance to supporting subsistence agriculture as this is regarded as perpetuating a negative perspective of Africa. It is therefore important that it is emphasised that the African Water Revolution will combine scientific and traditional methods in order to modernise rainfed agriculture, 'stabilise' subsistence farming and ultimately transform it into a source of wealth generation for farmers and nations. Any initiative should engage with programmes such as the NEPAD Comprehensive Africa Agriculture Development Programme (CAADP).

4.4.2 The role of the public sector

The public sector will be essential to ensure that it is possible to get to scale and to substantially transform rainfed agriculture, meeting African food needs and addressing rural poverty. The role of government is therefore key to success, including the commitment of public expenditure, which is an indication and measure of political commitment. Government needs to be included at all levels including:

- Regional and continental level – Essential to promote shared perspectives and the sharing of experience of improved rainfed agriculture programmes where green water capture, conservation and use has been key to success.
- National and provincial level – The national level is where political commitment is translated into policy and subsequently into budgets and mandates for ministries and departments, without which action at scale will not be possible. Critical to success is the need for a multi-sectoral approach which integrates the activities of different government departments such as water, agriculture, conservation, land, rural development etc.. Green water offers a particular challenge as it has not traditionally been considered as an area of activity or responsibility in either agriculture or water. This needs to be rectified with clear mandates and responsibilities. National governments also play a critical role in ensuring that an enabling environment exists to support, promote and regulate the role of the private sector in the agricultural and food production and marketing sectors.
- Local government level – Local government in the form of Local District Development Councils or their equivalent, including traditional governance structures, are critical to communicating with and supporting small farmers without which large scale programmes of small farmer support will not work.

4.4.3 Private sector involvement

The formal and informal private sector plays a key role in rural Africa – it is estimated that one in two rural households operate an informal small business of some sort from vending to transport (Nagler, P. and Naudé, W. (2014)). Much of this non-farming activity is to supplement income in the uncertain context of African smallholder rainfed agriculture and is intermittent with small businesses coming into and going out of existence continuously. These activities act as a form of insurance to provide alternative forms of income in case of crop failure. The stabilisation of rainfed agriculture, through reducing the occurrence of crop failure by improving green water usage, would enable farmers to meet their direct needs and produce excesses to trade which would provide opportunities for farmers to enter the agricultural value chain and build household wealth which would in turn strengthen local economies.

There are a number of initiatives throughout the continent aimed at improving the health of rural economies through supporting smallholder farmers and rural small and medium enterprises (SMEs). Some of these are supported and driven by national governments and others by donors, NGOs and large companies in such areas as financial services (providing credit and insurance), out-grower schemes, marketing support and support with inputs such as fertiliser and seed varieties.

The role of the private sector and social enterprise (the use of instruments such as community saving clubs, cooperative local banks, bulk-buying clubs etc.) is critical in rejuvenating rural economies and building wealth as this cannot generally be done by the public sector. The public sector has a role in enabling enterprise to flourish and regulate its excesses which often put the smallholder farmers at a disadvantage in selling their excess produce.

4.4.4 Public awareness and support

Widespread promotional campaigns which communicate the vision and intention of small farmer support policies and programmes should be used to create awareness in the population in general and the small farming community in particular. Awareness of the potential for increasing productivity and income is needed, together with what support is available. Awareness is needed to overcome risk aversion and years of myth and poor practice which have often become entrenched, such as crop preferences.

4.4.5 An inclusive context

Successful small farmer support programmes including green water use referred to in the literature (World Bank, 2016) and observed in anecdotal cases have had the common trait of including a wide range of different players and stakeholders which are inclusive of a broad spectrum of community interests including traditional leadership structures, local government, community structures such as water committees, faith based communities and organisations, civil society, and NGOs. This wide and diverse spectrum provides a support base for small farmers, especially the most vulnerable in terms of poverty, through which the messages of improved rainfed agriculture can be variously interpreted and myths dispelled.

Box 4: The involvement of Faith-based organisations (FBOs) in rural agriculture

Faith Based Organisations (primarily Muslim and Christian) have been involved in rural development and agriculture in different forms in Africa for hundreds of years. Today FBOs can be divided into two main categories – those run by the organised religious structures of the different faiths and denominations, and those run as NGOs on a faith based ethos.

Because of the high level of religious adherence in Africa (97.8 percent – Pew Research Centre) and particularly in rural areas, the formal religious structures have considerable reach and influence. This can and is being used to support improved farming practice. The roles of FBOs is becoming increasingly recognised in the development community.

An example of a faith based initiative is the **Food and Nutrition Security Programme run by the Anglican Diocese of Central Zimbabwe** which uses locally generated funds to support a number of projects including farmer training, water harvesting and conservation, ecologically sound homestead practices, household food security and income generation.



(Image: © Diocese of Central Zimbabwe, 2018)

4.4.6 The role of external support

The role of external support for a Water Revolution in Africa is critical. Whilst the political mandate and implementation of large scale programmes to improve rainfed agriculture through the use of green water has to come from the countries themselves, there is a great deal which can be done to support such initiatives. These include

- Support of government
 - Rural regeneration policy and regulation support to create the enabling environment for large scale implementation.
 - Support sector integration between different sectors including rural development, agriculture, water, transport, marketing etc. through promoting interaction, training and capacity building.
 - Stakeholder engagement, especially farmer support – Assist the public sector to engage with stakeholders, particularly at local farm level, through mobilising and supporting a range of different players which government may not have worked with previously.
 - Technical Assistance support in the technology and practice of green water capture and soil moisture use, including training etc.
 - Financing support through both credit and grant financing of large scale rural regeneration projects supporting small holder rainfed agriculture. This is addressed more fully below.
- Research and analysis through large scale pilot programmes covering technical aspects of green water capture and use, and the social aspects of small holder support related to risk management, perception and myth realignment.
- Advocate for political alignment to support rural regeneration. Support regional and continental initiatives aimed at promoting and adopting green water based improved rainfed agriculture including seminars, summits etc., particularly related to the achievement of the SDGs.
- Support to small holder farmers and rural community groups. Although the public sector should be the primary motivators and implementers of improved rainfed agriculture at scale, alternative sources of finance for farmers and community rainfed farming initiatives may be useful especially as demonstration projects at small to medium scale in order to prove the practice and methodology and provide state actors with confidence to go to larger scales.



Figure:6 Efficient watering systems – hand watering from a dipping well.

(Source: Dabane Trust © 2018)

4.5 Contributing to existing Pan African and global initiatives

4.5.1 African initiatives

The Africa Water Revolution initiative will not exist and function in isolation. There are a number of initiatives at continental and regional levels which are related and complimentary. The over-arching Pan African context is provided by the African Union's Agenda 2063. Agenda 2063 is a strategic framework for the socio-economic transformation of the continent over the next 50 years. Its builds on, and seeks to accelerate the implementation of past and existing continental initiatives for growth and sustainable development including:

- The Lagos Plan of Action – 1980;
- The Abuja Treaty (The African Economic Community Treaty - 1991);
- The New partnership for Africa's Development (NEPAD) – 2001;
- The Comprehensive Africa Agricultural Development Programme (CAADP) – 2003;
- The Minimum Integration Programme – 2010;
- The Programme for Infrastructural Development in Africa (PIDA) - 2012,
- The plans of the Regional Economic Communities; and
- National Plans.

Other initiatives which similarly endorse action to address rural poverty, improved agriculture, the food crisis and economic development include the Malabo Decision on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods, June 2014, the ongoing work of NEPAD, especially the Comprehensive Africa Agricultural Development Programme (CAADP), and the African Development Bank through TAAT - Technologies for African Agricultural Transformation - which is a key priority of the African Development Bank's agricultural transformation agenda also known as the Feed Africa Strategy. There are also specific water related projects such as the Billion Dollar Business Alliance for Rainwater Harvesting to contribute to improved livelihoods and resilience for small-holder farmers in the drylands of Sub-Sahara Africa being piloted in Kenya.

The African Water Revolution initiative and the proposed Green Water Fund is unique in that it is focused on green water – the capture, storage and utilisation of soil moisture – to enhance rainfed agriculture. It is complementary to a number of other programmes and supportive of the vision and objectives of by the African Union's Agenda 2063.

4.5.2 The Sustainable Development Goals

The African Water Revolution will contribute directly and indirectly to seven of the Sustainable Development Goals.



5 Financing the Water Revolution

5.1 The case for public financing of green water.

As has been indicated in several places in the sections above, there is a strong case to be made that investments in green water as the basis for improved rainfed agriculture should primarily be the responsibility of national governments. There are multiple reasons for this as follows:-

- An issue of national importance – The wellbeing and productivity of two thirds of the population who depend on rainfed agriculture for food and income generation is a matter of national concern in most if not all African countries. In order to address the multi-faceted problem at a scale, political leadership and governance is required through the organs of state.
- Food production – Africa currently is a net importer of basic food in a context where internal food production is substantially under performing and where it could more than meet its own needs through improved rainfed agriculture (60 percent of the world's uncultivated arable land is in Africa). Food imports are required to address recurrent large-scale food crises faced in many parts of the continent due mainly to weather related crop failure which result in very high rates of malnutrition. It is clear that food requirements cannot be met through irrigated agriculture alone but could be met with improved rainfed agriculture which harnesses the continent's green water potential. However to do so at scale requires the commitment and involvement of the state.
- Disaster Risk Management - Substantial state resources in many countries are committed to disaster risk and emergency management, often geared towards coping with the impacts of drought and failed harvests at large scale, particularly in subsistence rainfed areas which is where the majority of the population of Africa lives. Most of this is reactive and is not geared towards preventative measures at scale.
- National productivity – There is a strong drive throughout Africa to provide jobs and thereby to increase the productivity of African economies. Much of this drive is urban and industrially based. Where it is agriculturally oriented, it is usually targeted towards high value commercial agriculture, mostly related to irrigation. There generally appears to be little emphasis placed on addressing rainfed small holder agriculture from the perspective of its potential to contribute to national productivity. The regeneration of rural economies through supporting improved rainfed agriculture at scale would potentially contribute greatly to national productivity as a whole.
- Reduction of food imports – Enabling the continent to be self-sufficient in food production through investment in green water based improved rainfed agriculture will reduce the drain on national accounts due to the costs of importing basic food, thereby improving the balance of payments accounts of Africa as a whole.

For these reasons it is clear that the public sector needs to lead large scale programmes to improve rainfed agriculture, supported by the international development sector and, where feasible, by the private sector. Public sector financing could include a range of different fiscal mechanisms and activities such as subsidies, public work programmes, farmer support and extensions services, micro-credit for inputs, market access roads, small scale infrastructure such as small dams and rainfall harvesting, etc. The multi-lateral development agencies such as the World Bank and the African Development Bank may be sources of development credit accessible to governments for investments in improved rainfed agriculture and rural economic regeneration.

5.2 Green water vs Blue water investments

Given the realities which face Africa and which are set out in the sections above, i.e. the food crisis, the prevailing levels of rural poverty, the constraints on blue water irrigated agriculture potential

and limited available public finances, there is a strong case to advocate that large-scale commercial irrigation should be financed by conventional commercial financing sources on the strength of each scheme's commercial merit and should not be wholly or partially financed from public funds. This, however, is not how public funds have been spent in the past. Most public infrastructure financing in the water sector has been of blue water projects with very limited funds being allocated to small scale productive water projects in rural areas (apart from WASH projects in support of potable water and sanitation services).

A new emphasis should instead be placed on financing green water for improved rainfed agriculture. The difficulty with this is that green water has not been a traditional area of responsibility and expertise in government water departments. Picking up this responsibility and capacity will require support and take some time.

The cost-benefit rationale for the public financing of large scale improved rainfed agriculture programmes is strengthened by the observations made in Chapter 3 and illustrated in Figure 3. The yield per dollar invested in improved rainfed agriculture is 6 times that for each dollar invested in large scale irrigated agriculture.



Figure7: Poverty induced land degradation in Mozambique, resulting in the sedimentation of reservoirs. (Images: Len Abrams © 2018)

5.3 Sources of finance

Sources of funds will need to be investigated and will possibly include the following which is made up of both redirecting existing sources of funding and proposing new sources:

- Redirection of drought disaster funding. Review existing funding of disaster risk management and response programmes, especially those related to drought risk management. Assess the potential for redirecting some of these funds to improved rainfed agriculture as a sustainable risk management strategy.

- Redirection of emergency food funds. Review existing emergency food response planning and financing for potential redirecting of funds to reducing the occurrence of crop failure and hence the need for emergency feeding through improved rainfed agriculture. (Research into the economics of emergency feeding interventions vs investment in improved rainfed agriculture.)
- Climate Change funding. Improved rainfed agriculture is essentially a process of building local level resilience to climate variability and climate change. The financing of improved, green water based rainfed agriculture could meet the access criteria of various climate change funding sources.
- Existing development funding. Large scale improved, green water based rainfed agriculture which will improve rural livelihoods is likely to meet the funding criteria of various existing rural development, agricultural and food security funding sources through the bi-lateral and multi-lateral development financing agencies.
- Payment for environmental services. The adoption at large scale of conservation based rainfed agriculture using green water approaches, and the reduction of poverty as a result, would have the effect of functioning as a catchment management programme with considerable downstream benefits. This constitutes an environmental service as it would result in a reduction of erosion and consequential sediment loads which reduce downstream water storage and increase water treatment costs. A case could therefore be made for meeting some or all of the costs of such a scheme out of the savings made by downstream beneficiaries.
- Mobilising new sources of finance. Various sources of possible new funding need to be investigated and motivated for the financing of improved rainfed African agriculture. Such funds, together with the sources noted above, could be applied to the establishment and capitalising of a new Green Water Fund dedicated to supporting green water use in Africa.

5.4 The Concept of a Green Water Fund

5.4.1 The concept

In the preceding sections a convincing case is made for embarking on a continental scale programme of rural regeneration through improved rainfed agriculture based on green water. Government commitment is essential for implementation. However there are significant obstacles to overcome.

Resources are needed to overcome these obstacles which provides the rationale for the establishment of a Green Water Fund. The fund would be available primarily to governments to enable them to access finance to support the planning, design and implementation of improved rainfed agriculture programmes at scale in their countries.

It is initially envisaged that the Green Fund would provide finance in different areas:

- Study and promotion of Green Water: Grant finance for research into improved rainfed agriculture including technical factors and social/political factors, high level promotion of green water use and development, awareness creation at government departmental level and of other stakeholders, etc.,
- Green Water Investment Preparation Support: Project preparation funds, for use primarily by governments, in preparing large scale green water based improved rainfed agricultural projects to the point of bankability including the costs of securing investment credit and packaging investment financing.
- Green Water Project Investments: Whilst the primary responsibility for supporting rural small holder farmers across Africa lies with national governments, there may be other parties such as farmers' associations, communal farmers' groups and SMEs who require finances for rainfed schemes or who could function as intermediaries for household access to the funds. The Green Water Fund may provide funding for project preparation

and implementation of green water based schemes, especially where such schemes may function as pilot or demonstration projects.

5.4.2 Establishment of a Green Water Fund

The establishment of a Green Water Fund would require detailed analysis and preparation which is beyond the scope and intention of this document. Such an analysis would need to thoroughly review existing and past approaches to determine why previous similar initiatives have succeeded or failed. Whilst numerous other initiatives have been established to address the funding needs of various related agricultural and rural development issues, none have focused specifically on green water. A specific green water initiative would clearly also need to work collaboratively with other initiatives.

There are a number of key elements related to the design, structure and operation of a Green Water Fund for Africa which would need to be determined. These include aspects such as the following:

- Hosted or stand-alone fund – There are advantages and disadvantages to whether the Fund is hosted within an existing organisation or is an entirely independent autonomous new institution. A new institution would ensure that the Fund carried with it no negative legacy issues but would incur the costs of establishment and maintenance. A Fund hosted by an existing organisation would share that organisation's reputation and benefit from being within an established institution. An existing host organisation would also provide the legal institutional identity through which to enter into funding and other agreements with recipients and other parties.
- Governance – The Fund would need to have a board or council which would be responsible for the strategic leadership and guidance of the Fund. It would also require a Finance Committee which was responsible for the allocation of funds to projects and the raising of finance for the Fund. Whether it was hosted or not, the Fund would require a technical secretariat to carry out day-to-day operational functions such as support for and appraisal of the preparation of project funding. The governance structure is likely to be influenced by the principal financial supporters and contributors of the Fund.
- Fund capitalisation and replenishment – The capitalisation of the fund would constitute a key component of its establishment and would require a detailed collaborative process which would need to be thoroughly motivated and designed in detail. In order to avoid such a fund becoming perpetually donor driven, capitalisation should include input from African countries. Depending on the modality of financing (loan, credit, blended) the fund would require periodic replenishment, the mechanisms of which would need to be designed and agreed at establishment. Eventually, if successful, replenishment could be entirely the responsibility of African countries. Sources of financing from African governments could include sources such as those identified in Section 5.3 above.
- Operational procedures – Operational procedures will need to be developed and agreed which would set out the criteria for accessing finance from the Fund, funding conditions to be met, different types of projects, reporting requirements, financial management procedures, and all other matters necessary to run the organisation.
- Promotion, advocacy and awareness creation – The Fund would need to have a distinctive role in advocating and promoting green water use and rainfed agriculture at all levels.
- High level endorsement – in order to be effective in influencing the course of development on the African continent, the Green Water Fund will need to be endorsed at the Head of State level.



Figure7: Increased yields using improved rainfed farming methods including mulching.
(Source: Dabane Trust © 2018)

6 Conclusion

The African continent has enormous potential for agricultural production which could more than meet its own food needs and contribute to the economic growth and wellbeing of the entire continent. However, the continent has a number of natural constraints which result in 95 percent of its potential cultivatable land being in the form of rainfed lands, most of which exist in dryland zones with highly variable rainfall. Sixty percent of Africa's population live in rural areas where most of them depend on rainfed smallholder agriculture for their food, their employment and their income.

In rainfed farming water is critical. The water which is available to plants in the form of soil moisture is called 'Green Water'. The water with which we are most familiar in rivers, dams, aquifers and pipes is 'Blue Water'. Virtually all of the investments made in water management and development is in blue water yet 90 percent of food production and 95 percent of agricultural land depends on green water.

The rural population of Africa is generally poor and subject to frequent and recurrent hardship due to drought and crop failure which results in high levels of hunger and malnutrition. Poverty and poor farming methods lead to wide scale land degradation and loss of fertility which in turn leads to further poverty. The net cost of food imports to Sub-Saharan Africa is USD35 - USD42 billion / year which is predicted to reach USD110 billion by 2025. 60 percent of the worlds uncultivated arable land is situated in Africa.

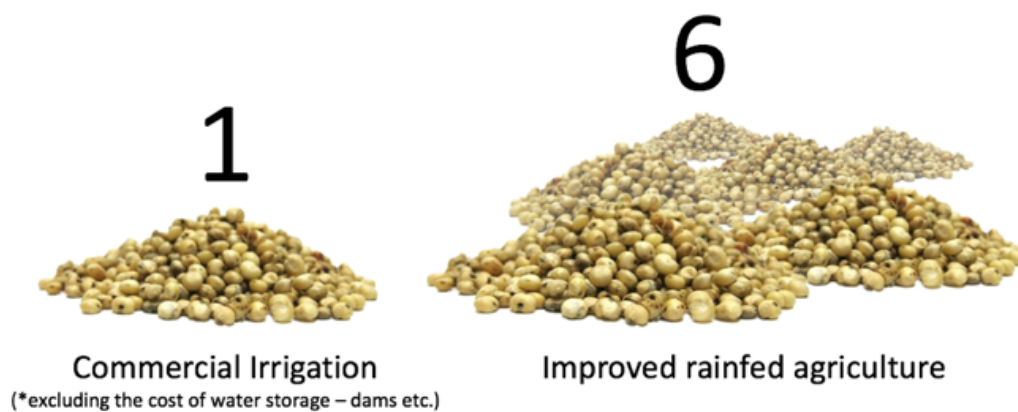
Adopting scientifically tested and traditionally proven methods of farming which captures and preserves green water, together with rainwater harvesting techniques, can substantially improve rainfed agriculture and break the vicious cycle of rural poverty. Investments in improved rainfed agriculture have been shown to produce 6 times more crop yield per dollar invested than investments in mechanised irrigated agriculture.

The African Water Revolution calls for investment in improved rainfed agriculture throughout Africa and the support of smallholder farmers to be able not only to feed their families, but to contribute to and benefit from the agricultural value chain, thus contributing to Africa's growth and well-being as a whole. The call for an African Water Revolution recognises that achieving these goals is very complex and requires the involvement and engagement of many different players at all levels including, most importantly, political leadership and commitment at the highest level.

The financing of improved rainfed agriculture can be achieved through a combination of new sources of funds and the reallocation of existing resources which are used to respond to the consequences of the current widespread failure of rainfed agriculture (emergency feeding, drought disaster management etc.). A Green Water Fund is suggested to underpin the African Water Revolution and to be able to address the crisis at sufficient scale across the continent to make a significant and sustainable impact through the regeneration of African rural economies.

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Yield per \$ of in-field* investment



(Source: Author, 2018)