A Lifetime's Record of Innovation and Experimentation:
Mr. Phiri's Water, Soil and Landscape Management Principles
as Exemplified on His Own Land

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VaPhiri is well known for his extraordinary abilities to convey his vision for community and agricultural development through water management in the dry landscapes of Southern Zimbabwe. His own farm is a living example of this approach, having been steadily and innovatively developed since the late 1960s and early 1970s. That's long enough to really answer some questions about the ecological intensification and sustainability of dryland farming.

Although just eight acres in extent (3.5 hectares) this farm is renowned as an oasis in a frequently drought-stricken region, and served as a magnate for visitors from all over the world, especially since the late 1980s. Some of the countries people have visited from in Africa include Botswana, Kenya, Malawi, Mozambique, Namibia, Swaziland, Somalia, South Africa, and Zambia. People have also visited from many parts of United States and Europe. Within Zimbabwe there have been farmer exchange programs with Bikita, Chimanimani, Chivi, Marange, Mberengwa, Murehwa, Mutoko, Mutare, Mutasa, Nyanga, Sanyati and many other districts.

This short report and accompanying four layers of maps describe some of the principles and innovations that VaPhiri has manifested in this land over decades of stewardship.

The maps show something of the complexity of his eight acres through four levels.

- Level One: the underlying geology and soil
- Level Two: the physical structures through which VaPhiri has shaped soil and water behaviour in his land
- Level Three: how water flows and is managed in his land
- Level Four: some inkling of how he crops his land (the detail of which it is impossible to show, there is so much diversity, complexity and integration)

It is worth spending some time with these maps – they show how the careful tweaking of hydrological cycles has enabled a transformation in productivity of the land, both across the different fields, and through the seasons and wet and dry years.

Any University or Agricultural Research Center in the world would have been proud to have developed a set of rigorous experimental interventions of the kind he has achieved, and indeed it is difficult to identify anywhere in savannah Africa where a similar quality of work has been undertaken. Furthermore the work that he has been doing over the last half century is now being recognized the world over as exactly what we all need to be doing over the next half century: achieving intensification of production with minimal inputs of increasingly scarce water and nutrients, in ways that are not fossil-fuel

dependent, and which through their creative use of diversity and complexity provide resilience in the face of multiple environmental, economic and other threats. Ways that tighten nutrient and water cycles, by perennializing crops and integrating systems, and working with rather than against ecological processes. Passionately caring for water in a dry land; starting and ending everything with vibrant, living soils.

As such VaPhiri is a Old Man with the key to the future. He should be honoured with a PhD in the science of agriculture, as well as celebrated as a leader of the spirit and community. He combines the knowledge of tradition with that of experimentation. He is as comfortable with innovating through spiritual revelation as he is testing his scientific ideas with his hands, and knows that truth usually requires both of these applied together. He doesn't wait for anyone else to discover knowledge for him, lives yearning more truths, and never stops delighting in learning new things. VaPhiri's work flows from the intimacy he has with Creation. And in this is his genius.

1. Manage Water Flow Through the Landscape

VaPhiri characterizes what he does as separating water and soil (which otherwise want to leave the land together – "eloping" as he says in his colourful language) and then managing wetness in this semi-arid landscape (where there is never enough water to spread it around). He takes a LANDSCAPE approach to doing this, in the sense that he has studied not only the land that is his fields but the whole way in which water moves through the area from the bare granite crest behind his home through the fields to the valley below. Utilizing an indigenous understanding of how water flows into and through sandy soils until abutting areas of clay and rock which only became clear to hydrologists in the 1980s he has then made numerous interventions in that landscape to manage and direct water flow to maximize its availability to his different crops.

Importantly VaPhiri didn't make all the interventions at the same time. Instead he made the interventions one at a time over more than thirty years so that he could study the results and learn what really worked. Meanwhile he also gathered new ideas from other farmers to add to his innovations, and he constantly sought to discover how much water he could actually harvest or conserve from different measures in years that might be wetter or drier than average.

Here are some of the lessons that he has leaned and communicates so well within his farm:

a. **Slow water movement** (maximizing erosion control and infiltration) to make sure that every drop of rainfall is made full use of in a climate where most of the little rainfall that comes in a year falls in less than a dozen large storms.

    i. As the water comes cascading off the bare granite ("ruware") that comprises the huge inselberg crest behind his home it has a high capacity to erode and were it to enter the drainage lines much could leave the farm within minutes without entering the soil. In the 1980s

VaPhiri therefore constructed dozens of stone walls, earth bunds, sand traps, run off dams and ditches and so forth in the area around his homestead and along the boundary of the ruware with the sandy soils characteristic of the region. This complex enables a huge quantity of water to slowly seep into the soils and flow gently down-slope and within the sandy soils into the field region below.

ii. VaPhiri developed a new way to think about contour ridges. Since the mid-twentieth century agricultural extension has made contour-ridging obligatory for Zimbabwean peasant farmers. These ridges are designed to hold back rain during large storms and channel escess water into non-farmed drainage lines. VaPhiri did not like to see water gathering up and gaining force, and then escaping fields causing erosion and drying in the process. Therefore he adapted a pitting system he had heard about from other innovative farmers and began in 1987 to construct pits in the troughs above the contour ridge to capture and enable infiltration of heavy rainfall. He called this new approach "Phiri Pits", and gradually extended the practice down the fields through the 1990s, with the lowest pits being large oblongs capable of holding substantial amounts of water. He has also built Phiri Pits to capture water draining from the road, and dug large trenches at the top and bottom of his land to prevent water flow.

iii. Since rain can always gather in the farm access paths that run down-slope into his fields and so cause erosion VaPhiri actively manages these, managing their drainage and protecting them with stones wherever water flows, including those adjacent to his fields where erosion could impact them negatively.

b. Innovations for **managing the water in the wetland itself** are central to VaPhiri's genius. What happens in natural wetlands in this environment is that water flowing from granitic hills and sandy soil aquifers comes up against accumulations of clay or impermeable rock areas down-slope and rises to the surface as springs and wetlands. These "makuvi" or "vleis" as they are locally known provide rich areas for grazing, excellent well sites, and productive farming areas for wetland crops during the rains and vegetables in the dry season. They have long been central to survival in these Zimbabwean environments (and their use was banned by colonial governments). What VaPhiri discovered he could do was more than these traditional uses: he found that he keep more of the water in the wetland during the rainy season than occurs naturally. To do this he separated some of the water from the soil and concentrated it in pools to make more of it storable, as well as to make it more manageable (avoiding water-logging) and ready for redistribution across the land as needed. In achieving this he transformed his productivity and resilience.

i. To prevent water flowing out of the wetland during wet periods VaPhiri strategically dug ponds in the drainage line and used the clay removed

from the pond and from termite mounds to make a sealed dam wall to prevent water leaving through surface flow. (See diagrams)

ii. These ponds were constructed in stages between 1973 and 1998, starting in the middle of the wetland and then extending above and below according to demonstrated available capacity. In 1999 the three small ponds had an estimate 1.5-1.9 million liters of water storage capacity. Because of their steady recharge these ponds actually allow management of a much greater volume of water over the course of a year, which is pumped out to make way for new inflows. The ponds are small and simple enough to be dug by hand, or as more recently, by using an ox-drawn scoop.

iii. Not only do the ponds make the water available for agricultural and non-agricultural use but they also separate it from the soil itself which prevents water logging of prime areas, and consequent loss of workability and fertility. This means that having ponds increases yields in wet years as well as in dry years, something critically important in this variable environment.

iv. VaPhiri argues ponds should be small but deep. This saves scarce land and reduces evaporation. Mr. Phiri's three ponds are 3m, 1.5m and 1m deep respectively. There will rarely be much water in an environment like this one – he argues not to make the ponds too large: his ponds are 37m, 30m and 21m at their widest points, and that was only after he had proved there was enough water for such size.

v. Surrounding the ponds with shade trees, reeds, banana groves etc keeps them cool and sheltered and reduces evaporation.

vi. Stored water can then be released into the fields on the edge of the drainage line. To do this VaPhiri has constructed many canals and ditches over the years, some lined with clay, others with brick and cement. Some of these canals work purely by gravity with overflow from the ponds, and others are started with simple pumps, and they distribute water across the land by traversing the slope – taking it across the slope in the opposite direction to how it flows naturally. This enables VaPhiri to regulate plant moisture availability in neighboring field areas both through the rainy season (where mid-season droughts can be devastating, especially to maize) and in the subsequent dry season. Half a dozen field areas with an area of about two acres (one hectare) can be irrigated in this fashion, depending on need and availability. Thus the ponds supplement the wells that he dug in the early 1970s on the land, some of which he also irrigates from.

Manage Soils for Water and Clay Content

VaPhiri knows his soils well and manages them closely according to their clay, organic matter and moisture content.

a. The most intensive agriculture is sustained on the clay-rich true wetland soils; often with perennial crops (see below). These wetland soils receive the highest levels of cattle manure input, as well as mulching with green manure. This sustains fertility, avoids nutrient loss through water-logging and reduces risk of erosion
b. VaPhiri maintains an irregular land surface: he doesn't smooth out the land which would speed drainage. He has higher areas and lower areas throughout each field and takes advantage of these micro-climates with a mosaic of different crops that are intercropped together. In a wet year the crops in the higher/drier spots will do better: in a drier year the lower wetter places will have the advantage: by intercropping in an physically irregular environment the farmer always wins.
c. Wherever there is a risk of water flow he prevents erosion by maintaining complete plant cover, e.g. with Kikuyu grass.
d. In the sandier areas the soil can hold neither moisture nor nutrients, so VaPhiri works to increase the clay content, particularly where there is sufficient water. He does this through bringing cartloads of termite mound soil from within the farm or offsite (a common Zimbabwean practice), and more unusually by transferring the clay soils dug out of the ponds into needy areas. This was particularly effective with the clay from the third pond dug in 1998 which was adjacent to an area of wet very sandy soil which could therefore be significantly enriched by this clay for future cropping.

Plant and Maintain both Indigenous and Exotic Tree Species

Trees are celebrated across VaPhiri's land. In 1999 a survey of his homestead plot (which is just 52m times 80m at its widest point) found that he had 149 trees there of 41 species (including 11 exotic fruit tree species, 15 indigenous fruit tree species, 4 non-fruit tree exotics – mostly decorative or medicinal, and 11 indigenous non-fruit tree species with varying uses). VaPhiri's long-standing enthusiasm for indigenous trees was strengthened in the mid-1980s by the work of his colleagues in neighboring Mazvihwa. For example the now late Black Chakavanda gave him a seedling of a baobab (having learned from the elders how to germinate that plant), which VaPhiri planted outside the kitchen in 1986, and which is growing well.

The trees in his fields are too many to count, but is several thousand. There are several small woodlots, including a small block at the end of the property, several orchard areas, a large grove of bananas, many indigenous and exotic trees left or planted in the fields themselves, and hundreds of trees encouraged on the contours and fence lines. Some 18 species were recorded as common in a survey of the property in 1999, mostly indigenous species. An aerial photograph from around 2000 revealed the presence of around 100 large trees, especially mangos, one of the species that VaPhiri first planted in big numbers. VaPhiri's mangos are well known for their size and quality.

Inter-Crop, Rotationally Crop, Integrate Legumes, Establish Perennials

VaPhiri practices a wide diversity of crop rotations tailored to the different soil-water situations across his farm, typically integrating legumes to sustain soil nitrogen levels. Important legumes for VaPhiri include groundnuts, roundnuts, beans, and cowpeas. VaPhiri abandoned fertilizer use because of its long term impacts on soil structure and health, and therefore emphasizes leguminous crops, green manuring and manure use.

Maize of course remains the dominant crop – both for food and sale. In 1999 VaPhiri harvested eight tons of maize from his main field and another ¼ ton from the homestead plot. But he also grows other cereals, including sorghum, rice, and even wheat; sweet potatoes, and a wide variety of vegetables (including peppers), the legumes mentioned above and even cotton and sunflowers as cash crops.

VaPhiri likes to minimize the sight of bear earth. In a region where almost all agriculture is based on annuals crafted to grow rapidly during the brief period of rains he instead has developed significant focus on perennial (or at least multi-year) species, especially in the wettest areas. This includes areas of bananas, reeds, bamboo, sugar cane and a Colacasia yam (tsenza), as well as several types of fodder grasses and species like cassava and cow peas intercropped in the fields. And of course all these are mixed together with the tree species mentioned above.

Farm Diversity and Integration

VaPhiri emphasizes the ecological, nutritional, economic and aesthetic values of cropping diversity. He experiments with different varieties of these many different crops. At the same time as he defends ancient indigenous varieties for their special properties he is also an enthusiast of new exotic crops and other plants. He is often the first person in his community to try a new plant – like Kikuyu grass – as well as someone who sticks with traditional varieties that work. He emphasizes unusual crops such as tree cassavas (particular varieties which grow taller and older) which have edible leaves, something eaten in his father's Chewa homeland, but much more rarely in Zimbabwe. The reeds that he grows around his dam have served as major income sources during droughts when basket weavers buy them to earn a living. Diversity on his farm helps him control pests, weeds and diseases; VaPhiri also uses many traditional and contemporary non-chemical methods to control diseases, including using medicinal plants he grows on the farm. (VaPhiri minimizes chemicals and fertilizer because of their long term consequences to the ecological health and economic productivity of his land, as well as for financial reasons and self-sufficiency).

VaPhiri also strongly believes in integrating his farming operations. His livestock rely heavily on crop residues from his fields, and also from the extensive hand cutting of his cultivated grasses that sustain the contours and drainage lines. This means he can keep a larger number of animals than would be possible if he relied on the communal grazing, and, especially important, fewer die during the regular periods of drought that impact this region. In turn the manure from the livestock sustains the superior fertility of the fields, so by building tight and reinforcing nutrient cycles he builds a virtuous cycle of

productivity. Larger holdings of livestock provide the extensive draught inputs he requires for ploughing, cultivating, harrowing, carrying harvests, soil and other items around the farm throughout the year. With livestock for traction on a small piece of land VaPhiri does not particularly lack for a tractor.

VaPhiri always seeks additional components to further tighten and integrate his soil and water cycles. He farms fish in his ponds, and developed bee keeping which has been very successful within the banana groves. He keeps rabbits and has crop residues and greens for them throughout the year.

The wide diversity of crops, livestock and other products provide him with a steady and resilient income through the vicissitudes of economic and ecological crisis, cycle and change. What he has built up has been done not through financial investment, but instead through deploying human and natural capital. He and his family have worked hard to create and sustain the farm. Everything has been done with their hands and oxen, and almost nothing has been purchased that is out of the reach of other small farmers. VaPhiri's wide networks upon which he has shared his wisdom and experience have brought back to him countless seed varieties, innovations, and support in times of need.

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Dr. K. B. Wilson first starting learning from VaPhiri in 1981; worked with him as a friend and colleague in 1985-1988 while a doctoral student at University College London and Associate of the Dept of Agriculture at the University of Zimbabwe. It is connection that has endured ever since.

Irma Gogiashvili generously spent many hours rendering the maps and diagrams in July 2010 which were based on a field assessment of VaPhiri's land in the dry season of 1999 during which Louise Thandiwe Wilson, then aged six, wrote down most of the numbers.