# The Use of Indigenous Knowledge in Subsistence Farming: Implications for Sustainable Agricultural Production in Dikgale Community in Limpopo Province, South Africa

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**Abstract:** The present study examined community-based mechanisms of continued subsistence farming under unfavourable environmental conditions. Semi-structured interviews conducted with a sample of 250 participants showed that community members sustain farming through their indigenous knowledge. Community members continue subsistence farming in their home-gardens and ploughing fields through indigenous farming practices and rainfall prediction. The practices involve improvement of soil fertility and structure, maintenance of crops, and seed selection and storage for future planting. Knowledge of rainfall prediction is helpful in planning the planting season. These indigenous practices could be helpful in the achievement of the United Nations' Sustainable Development Goal on food security, which requires a nutritionally adequate and safe food supply at household levels.

## 1. Introduction

Indigenous knowledge is a systematic body of knowledge acquired by local people through accumulation of experience, informal experiment, and understanding of their environment [1]. The indigenous systems of crop production emerged over centuries of cultural and biological evolution and represent the accumulated experiences of indigenous farmers. The farmers produce indigenous crops through knowledge of environmental conditions and seasonal change without access to external inputs, capital, and modern scientific knowledge [2]. After centuries of cultural and biological evolution, communities have developed locally-adapted, complex farming systems that have helped them manage a variety of environments to meet their subsistence needs [3]. Indigenous crop production provides rural communities with food resources [4].

According to Azam-Ali [5], production of indigenous crops forms the basis of subsistence agriculture in sub-Saharan Africa. Food is produced from cereals, legumes, cucurbits, cowpeas and groundnuts, bulrush millet, finger millet, sorghum, gourds, melons, and pumpkins. These crops are produced in subsistence farms and home-gardens as abundant food sources. For Sigot [6], throughout the African

continent, small plots of land near homesteads are used as home-gardens. The gardens provide households with a range of plants that provide food. Van Wyk [7] posits that indigenous cereals provide food security to small-scale farmers because they are tolerant of poor soil and drought.

Subsistence farming is rapidly disappearing due to major social, political, and economic changes [8]. Conservation and management of subsistence farming practices may be possible only if they are linked to the preservation of the cultural diversity and economic viability of the local farming populations [8]. Rook [9] observes that many indigenous crop production systems are characterized by low productivity and instability of production. Marginal and erratic rainfall is responsible for poor crop productivity. Poor growth and yield are attributed to low soil and ambient temperatures which drop below the minimum root and shoot growth temperature of 10 °C [10,11]. The inadequacy and uncertainty of rainfall and its uneven and irregular distribution is compounded by low fertility and high fragility of soils.

However, indigenous knowledge enables its owners to enhance subsistence farming at the time of seasonal and climatic variability [12]. Subsistence farming is sustained through indigenous adaptation mechanisms [13,14], which Reid and Huq refer to as "community-based adaptation" that "can be defined as 'community-led process, based on communities' priorities, needs, knowledge, and capacities, which should empower people to plan and cope with the impacts of climate change'" [15]. Indigenous knowledge used in subsistence farming could be promoted as an adaptive mechanism to sustain the livelihood of rural communities with the potential of securing food [16]. The present study examined community-based mechanisms of continuing subsistence farming under unfavourable environmental conditions.

## 2. Methods

### *2.1. Study Area*

The study was conducted among the Northern Sotho of Dikgale community in Capricorn District of the Limpopo Province, South Africa. Dikgale community is located within Polokwane Local Municipality, approximately 40 km from Polokwane City, and 15 km from the University of Limpopo in Mankweng Township. The community covers an area of 71 $km^2$ (6 km $\times$ 10.8 km). It is situated between 23.46°–23.48° south latitude and 29.42°–29.47° east longitude. It lies at an average altitude of 1400 above the mean sea level. The study area is on the Highveld Plateau, which is bounded in the south and southeast by the Strydpoort Mountains and in the east and northeast by the Wolkberge. Dikgale area has an annual rainfall of approximately 505 mm. It has a daily average summer temperature of between 16 °C and 27 °C, with the average winter temperature between 5 °C

and 19 °C. Summer rainfall occurs between October and April, followed by a dry winter season [17].

Dikgale community has a population of about 45,083 with a population density of 116 per $km^2$. The primary language spoken by community members is Sepedi. Dwelling units consist of conventional brick houses and fewer huts. The residential area is made up of demarcated housing stands with a block of ploughing fields in a flatter and sandy area [18]. A small number of community members grow subsistence crops in the home-gardens and fields to provide the additional dietary requirements of a balanced intake [18,19].

### *2.2. Study Design*

A qualitative study was conducted to examine sustainable production of subsistence crops. Data were collected through direct interactions with participants.

### *2.3. Participants*

The study population was Dikgale community. A short survey was conducted in the community prior to data collection with the objective of identifying potential units of analysis. The potential units of analysis were residents in Dikgale community, whose home-gardens and fields have signs of recent subsistence crop production. Two hundred and fifty households were purposely selected. Semi-structured interviews were conducted with 250 bread-winners drawn from the households. The participants aged between 25 and 87 years. They were 98 males and 152 females. They consented to participate in the study via signing of the standard university consent form. The interviews were conducted in Sepedi, the local dialect; in the comfort of the participants' own households.

### *2.4. Data Collection*

Semi-structured interviews were used to collect data. Three master's students were trained and have assisted with data collection and analysis. The participants were asked questions about the indigenous knowledge used to endure subsistence farming. Data analysis was effected through a computerized software package and content analysis.

### *2.5. Quality Criteria*

Comprehensiveness and trustworthiness of collected data were attained through reviews of data with the participants. The participants were able to provide corrections to the inconsistencies, contradictions, and data gaps. Consultations were made to validate and clarify data.

## 3. Results and Discussion

### *3.1. Subsistence Farming*

The participants were asked to describe subsistence farming. The responses to this question reflect that community members provide supplemental food for their families through production of indigenous crops in the home-gardens surrounding the compound and ploughing fields allocated to each household by the chief-in-council. The fields are usually located within reasonable walking distance from the villages and are arranged in a rectangular pattern. An average land holding is two hectares per household. Strips of uncultivated grassland separate the fields. Tractors are available for hire at a cost of about 900 South African Rand (ZAR) per hectare. Planting of crops generally commences after the first rain has fallen. The seeds are mixed and sown simultaneously to grow the crops together in the same field.

### *3.2. The Use of Indigenous Knowledge to Sustain Subsistence Farming*

The participants were asked questions relating to the indigenous knowledge community members use to sustain subsistence farming. The responses provided show that community members use their indigenous farming practices such as planting on different soil types, soil fertilization, selection and storage of seeds and maintenance of crops. In addition to these knowledge systems the participants mentioned the use of knowledge of rainfall forecast. These indigenous knowledge systems are produced by local people based on their lived experiences [20]. The Food and Agricultural Organisation (FAO) [21] attests that local farmers and indigenous communities have indigenous knowledge, expertise, skills, and practices related to sustainable agricultural production.

#### 3.2.1. Rainfall Forecast

It was established during the study that the participants use signs, such as the sprouting tree leaves and flowers, to predict rainfall. The beginning of summer is marked by the flowing and leaf sprouting of *Senegali* species. In addition to this plant phenology, the appearance of stars, moon, and the sun are carefully observed at the beginning of September, which marks the beginning of a new season. It is believed that the signs of these celestial bodies denote a good or bad season. For example, 78% of the participants showed that if mahlapolane (Mars) lies towards the west, it predicts a good year, but if it disappears towards the east, it predicts a bad season with little rain. It is also believed that if the horns of the crescent moon point towards the Earth, it pours out rain, but if it points away from the Earth, it holds the rain. This indigenous knowledge of forecasting is used to plan the

planting season. Whenever a bad season is predicted, farming will not be done until it rains sufficiently.

The participants' knowledge of rainfall prediction corroborates Speranza et al.'s [22] findings that local farmers possess knowledge on the use of local indicators, such as plants, birds, insects, and astronomy, in predicting rainfall. Kijazi et al. [23] attest that people use the behaviour of animals and plants to predict the coming agricultural season. Chang'a et al. [24] show that this type of indigenous knowledge is important in farm decision-making to respond to anticipated poor yields. The use of *Senegali* phenology to predict rainfall in the study is also used by Malunga farmers in Tanzania to forecast the upcoming rainy season [25].

The participants' use of celestial bodies to predict rain is corroborated by the use of the moon and the stars by Chibelela farmers. The farmers use the moon's shape and colour as signs to predict a season of either sufficient or scarce rainfall. They also use the movement of stars to make inferences about the rainfall patterns for a specific season of the year [25]. Equally, in Uganda the farmers use local indicators, such as phases and shapes of the moon, to predict upcoming weather [26].

#### 3.2.2. Knowledge of Soil Types

Knowledge of soil varieties by colour and texture, and the types of crops that do well on particular soil types, was evident among the participants. According to the participants, black clayey soil is rich in nutrients and good for cultivation of maize, pumpkin, and gourds. Sandy soil is good for beans, melons, and sweet-reed. Another type of soil is a mixture of sandy and clayey soil which is good for all crops. These findings are supported by observations that Zulu subsistence farmers' knowledge of soil is based on colour and texture of the topsoil, that dark soil indicates higher fertility while lighter soil signifies lower fertility [27].

#### 3.2.3. Mulching

It was reported that previous harvest residue in the form of maize stalks, dried bean and nut plants is a good soil stabiliser. The participants reported that after harvest, the residue is tilled with the soil to improve moisture retention and fertility of the soil. This indigenous practice, according to Buthelezi et al. [27], replenishes depleted soil nutrients.

#### 3.2.4. Soil Fertilization

The participants reported that they apply kraal and poultry manure to make the soil regain fertility, retain moisture, and avoid pests. This type of soil fertilization mainly improves soil moisture conservation [28]. In Tanzania, subsistence farmers understand that if weeds are left to grow, they cover the soil, prevent it from heating

up or drying out excessively, induce a positive competition, which simulates crop growth and reduces erosion during rainfall [29].

#### 3.2.5. Seed Selection

The participants reported that, subsequent to harvesting, the crops are threshed and carefully stored for use. The seeds are carefully selected for planting in the next season. Good seeds are selected by colour. Only bright coloured and large-sized seeds are selected for planting. Sometimes selection of the best seeds is done by soaking the seeds in water. Only the sinking seeds are selected and the floating seeds are not selected. Olatokun and Ayanbode [29] observe that Nigerian women cull the seeds and preserve them for the next planting season. In Ethiopia, the farmers select healthy crops in terms of maturity period, height, colour, and size. The panicles or the spikes of the selected varieties are separately harvested, dried, carefully threshed, and the grains are saved for replanting [30].

#### 3.2.6. Multiple Cropping

Sowing of seeds is done haphazardly by hand. All seed varieties are sown simultaneously in the same field. This practice maximises the growth of all crops at the same time in the same field. Inter-planting allows cropping systems to reuse their own stored nutrients [8]. With this system productivity per unit area is higher than in mono-cropping systems with the same level of management. The farmers incorporate a variety of crops with different growth habits in the same field or home-gardens to maximise the chances for production of multiple crops [14].

#### 3.2.7. Maintenance of Crops

It was reported that subsequent to planting, when the crops are about four weeks old, weeding commences. Weeds are removed by hand or hand-hoe to avoid them competing for moisture with the crops, thus disturbing the growth of crops. In Tanzania, when the farmers regard weed competition as negative for crop growth, they perform superficial hoeing, and leave the weeds on the soil surface as protective mulch, to recycle nutrients, and to allow nitrogen assimilation through the bacteria decomposing the plants [31]. For the participants, when the crops are about to reach maturity, the women, boys, and girls spend days in the fields scaring birds off the crops. In many instances a "go-upa" ritual is performed through dispensing of medicine obtained from traditional health practitioners in the field to permanently remove birds and marauding animals from the fields. Olatokun and Ayanbode [29] observe that tobacco (*Nicotiana tabacum*) plants are used to prevent insect build-up on the cocoa plantation. In Indonesia, the farmers burn the common lake-growing plant called *Jariamun* (*Potamogeton. malaianus miq*) in the middle of the rice-field to drive pests from the farm [32].

3.2.8. Storage of Seeds and Crops

After harvesting and threshing, the crops are stored and prevented from attack by weevils. The crops remain fresh until they are all consumed. The most common preservation practice mentioned by the participants is by hanging the maize, sorghum and millet cobs from the hut roof. Sometimes the seeds are mixed with the ash of *Aloe ferox* and stored into clay-pots and baskets. The seeds could last for more than five seasons. Chili pepper (*Capsicum annum*.) is used to preserve harvested cowpea in storage [33].

3.2.9. Fallowing

In many instances exhausted fields are left fallow for two to five years. The participants agreed that this practice helps the soil regain fertility. During fallowing, cattle, sheep and goats are driven in the fields to browse course grass and that their droppings should add to soil fertility. Fallowing enables farmers capture the essence of natural processes of soil regeneration typical of ecological succession [34]. The use of "green manures", which is a recent discovery, intensifies the old fallowing technique in areas where long fallow periods are not possible anymore [34].

## 4. Conclusions

The study results show that indigenous knowledge is still valuable in the community. The knowledge is embedded in the community's cosmology. Knowledge of plant phenology, and the appearance and shape of the moon and stars is used to plan the planting of crops. The materials used to fertilise the soil, mulch, manage crops, and the seeds are procured at the household level. Soil fertilizers, mulching ingredients and crop management materials are locally developed, always available, affordable, and culture-specific. The study concludes that subsistence farming is sustained by indigenous farming practices and rainfall prediction. The practices involve the improvement of soil structure, maintenance of crops, and the selection and storage of seeds for replanting. Rainfall prediction helps community members plan the planting season. This indigenous knowledge is self-developed and relied upon to generate sustained crop yields to meet subsistence needs. The indigenous knowledge could be helpful towards the achievement of food security at the household level. The knowledge could also make contributions to the development of sustainable adaptation policies to assist rural communities which are vulnerable to climate change hazards.

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