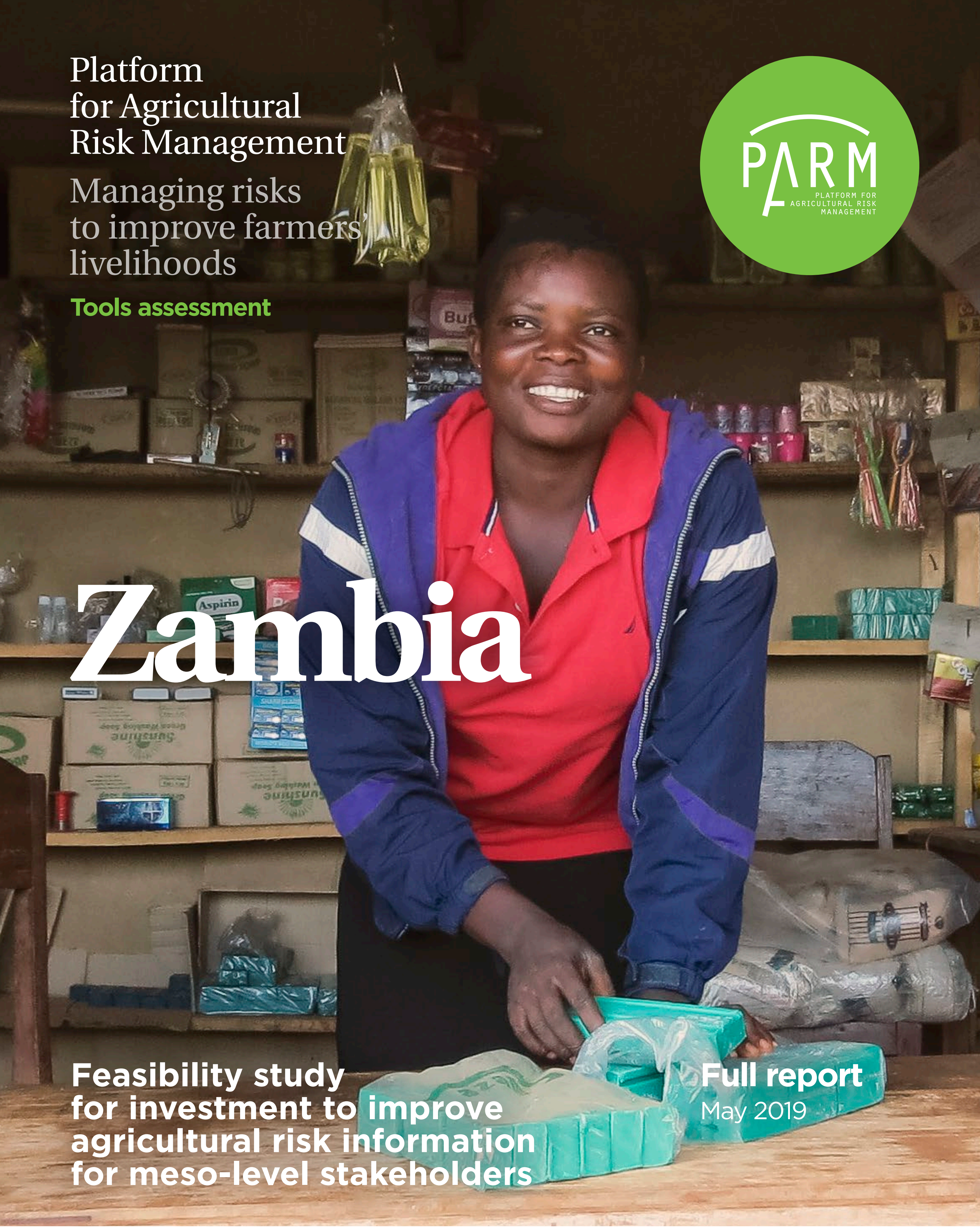

Platform for Agricultural Risk Management

Managing risks to improve farmers' livelihoods

Tools assessment

Zambia

Feasibility study for investment to improve agricultural risk information for meso-level stakeholders

Full report

May 2019

PARM

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Full Report

May 2019

Authors:
Grace Obuya, **Ngao Mubanga** and Prof. **Idowu Oladele**

Foreword

The Platform for Agricultural Risk Management (PARM) is an outcome initiative of the 2010-2013 G8-G20 discussions on food security and agricultural growth. It was established in December 2013 through a multi-donor partnership between the European Commission (EC), the French Development Agency (AFD), the Italian Development Cooperation (DGCS), the German Cooperation (BMZ/KfW) and the International Fund for Agricultural Development (IFAD). PARM works in strategic partnership with the New Partnership for Africa's Development (NEPAD) and other development partners to make risk management an integral part of policy planning and implementation.

This feasibility study report on "*Agricultural risk information for meso-level operators in Zambia*" responds to one of the risk management priority areas proposed in the World Bank agricultural risk assessment of 2018. The report was prepared by Grace Obuya with co-authorships of Ngao Mubanga and Prof. Idowu Oladele. It also received extensive inputs from the Ministry of Agriculture (MoA) and technical guidance from Dr. Ademola Braimoh, World Bank. Responses from a wide range of stakeholder (see Annexes 3 and 4) contributed to getting nuanced information for this report. The authors acknowledge and grateful for the efforts from all these stakeholders.

The content of this report was discussed with the MoA and national stakeholders during the PARM High-level Policy Dissemination/Dialogue Workshop in Lusaka, April 2018. Feedbacks from the workshop contributed to improving this report, which is still awaiting official validation from the Ministry of Agriculture.

Contents

List of acronyms and abbreviations

AfDB	African Development Bank
Ag Observatory	Agriculture Intelligence Observatory
AIS	Agricultural Information System
AMIC	Agricultural Market Information Center
ARM	Agriculture Risk Management
AWS	Automated Weather Station
CABI	Centre for Agriculture and Biosciences International
CBR	Cost-benefit Ratio
CIF	Climate Investment Fund
COMACO	Community Market for Conservation
COSOP	Country Strategic Opportunities Programme
DMDO	District Market Development Officers
DMMU	Disaster Management and Mitigation Unit
EAGC	Eastern Africa Grain Council
ENSO	El Nino Southern Oscillation
EWS	Early Warning Systems
FAO	Food and Agricultural Organization of the United Nations
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
FAW	Fall Armyworm
FARA	Forum for Agricultural Research in Africa
FGD	Focus Group Discussions
FISP	Farmer Input Support Program
FMD	Foot and Mouth Disease
FRA	Food Reserve Agency
GDP	Gross Domestic Product
GIZ	German Agency for International Cooperation
GTP	Growth and Transformation Plan
ICM	Information and Communication Management
ICT	Information and Communication Technologies
INFORNET	Information Flow Network for the Zambia Agriculture Research Institute
ISPMs	International Standards for Phytosanitary Measures
ITU	International Telecommunication Union
IVR	Interactive Voice Response
MoA	Ministry of Agriculture
MoFL	Ministry of Fisheries and Livestock
NAIS	National Agricultural Information Services
NALEIC	National Livestock Epidemiology and Information Centre
NAMBOARD	National Agricultural Marketing Board
NCP	National Contingency Plan
NGO	Non-Governmental Organization
NISIR	National Institute for Scientific and Industrial Research
NPV	Net Present Value
OIE	The World Organisation for Animal Health
PPCR	Pilot Programme for Climate Resilience
QC/QA	Quality Assurance/Quality Control

RADAR	Radio detection and ranging
RATIN	Regional Agricultural Trade Information Network
SADC	Southern Africa Development Community
SCARALA	Strengthening Climate Resilience of Agricultural Livelihood in Agro ecological
SMS	Short Message Service
SPS	Sanitary and Phytosanitary
TBPD	Transboundary Pests and Diseases
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WARMA	Water Resources Management Authority
WFP	World Food Programme
WII	Weather Index-based Insurance
ZMD	Zambia Meteorological Department
ZARI	Zambia Agricultural Research Institute
ZAMTEL	Zambia telecommunications company network
ZANACO	Zambia National Commercial Bank
ZAMACE	Zambia Commodity Exchange
ZAR4DIN	Zambia Agricultural Research for Development Information Network
ZIAMIS	Zambia Integrated Agriculture Management Information System
ZICTA	Zambia Information and Communication Technologies Authority

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Executive summary

This report focuses on the information on weather variability, pests and diseases, and price volatility, and how they can be effectively limited through agricultural risk management information systems tailored to the conditions prevailing in Zambia's agricultural sector. In supporting these efforts, a feasibility study was conducted to improve current agricultural risk information system in Zambia with meso-level operators as the main end user. Meso-level operators are those actors, active along agricultural supply chains that are directly in contact with farmers. They include public and private extension services providers, financial intermediaries, input providers, insurance companies, farmers' organizations, cooperatives, cross-border traders associations; research institutions and grain millers associations among others). Agricultural meso-level operators represent an optimal channel to reach a large number of smallholder farmers and also the bridge to policy makers at macro level.

The study developed recommendations and a corresponding investment plan for an integrated agricultural risk and early warning information system to help the meso-level operators and smallholder farmers to better manage risks related to weather and climate variability, pests and diseases, and price volatility. The study aligns with four key national initiatives in Zambia, the first is the National Agricultural Investment Plan (NAIP) whose objective "to facilitate and support the development of a sustainable dynamic diversified and a competitive agricultural sector that assures food security at household and national levels and maximises the sector's contribution to Gross Domestic Profit (GDP)", the second is Vision 2030 that aims to ensure an efficient competitive sustainable and export-led agriculture sector that assures food security and increased income, the third is the second National Agriculture Policy 2016 that focuses on ten strategic objectives that include objectives promoting productivity, promoting R&D, strengthening training, promoting markets (inputs and outputs), private sector participation, nutrition and food security, while the last is the Seventh National Development Plan (7NDP) which intends to create a diversified and resilient economy for sustained growth and socio-economic transformation driven, among other, by agriculture.

Survey of Agricultural Risk and Early Warning Information Systems

A number of meso-level operators were purposively sampled to obtain information on access to agricultural risk information for decision making in Zambia. Of this, 18 meso-level-operators responded to the online survey questionnaire and whose responses are analysed in this study. The responses from meso-level operators were supplemented by feedbacks from 35 other informants that participated in interviews in Lusaka and 4 focus group discussions (FGDs) in Gwembe and Chipata districts. Information from official documents was also reviewed to gain an improved understanding of agricultural risk and early warning information needs for meso-level operators in Zambia.

The study investigated and analyzed agricultural data collection methods; monitoring and early warning systems; analysis and reporting; and dissemination methods of agricultural risk and early warning information. Use of new technologies and traditional dissemination channels were investigated. Information needed for weather, pests and market risks was analyzed. The study also revisited existing information systems and possibilities of converging them into an integrated Agricultural Risk Management (ARM) information systems, easily accessible by meso-level operators and smallholder producers. Relevant best practices and lessons from other countries were also highlighted.

The survey revealed that a majority of the meso-level operators in the agricultural sector fall under the category of Government/Extension when compared to financial services, insurance companies, Farmer Organizations, research institutions, input suppliers, media and NGOs. Information requirements by meso-level operators are closely tied to their mission, goals and objectives as an organization. The information system influences the types of agricultural decision-making by meso-level operators in different ways.

According to survey respondents, extension service providers require the most information across the value chain ranging from pre-cultivation, cultivation, and harvest to, post-harvest information that includes market information to enable them offer appropriate advice to farmers. Insurers and insurance service providers also require similar information as extension service providers to design insurance products. For the design of weather index or area yield index products based solely, or partly on ground data (together with satellite data), rather than in-field assessments, it is also imperative to have access to good quality and quantity of weather and yield data (IFAD 2017)[1]. Other financial service providers, particularly those offering agricultural finance products, may require information about production calendars and costs, as well as sales prices.

Table A: Meso-level operators information needs in relation to weather, price, and pest and diseases

	Information needs	Extension services	Finance / insurance	Input suppliers	Farmer organizations	Research institutes	NGO
Weather	Accurate weather information	X	X		X		X
	Agroweather information	X		X	X		X
	Timely weather information	X	X	X	X		X
	Rainfall	X	X		X	X	X
	Flood	X	X		X	X	X
	Temperature variations	X	X		X		X
Market	Availability of agricultural inputs and services		X	X	X		X
	Access to quality inputs		X	X	X	X	X
	Marketing subsidies,		X	X	X		X
	Export ban		X	X	X		X
	Agricultural insurance participants		X	X	X		X
	Agricultural markets participants		X	X	X		X
							(...)

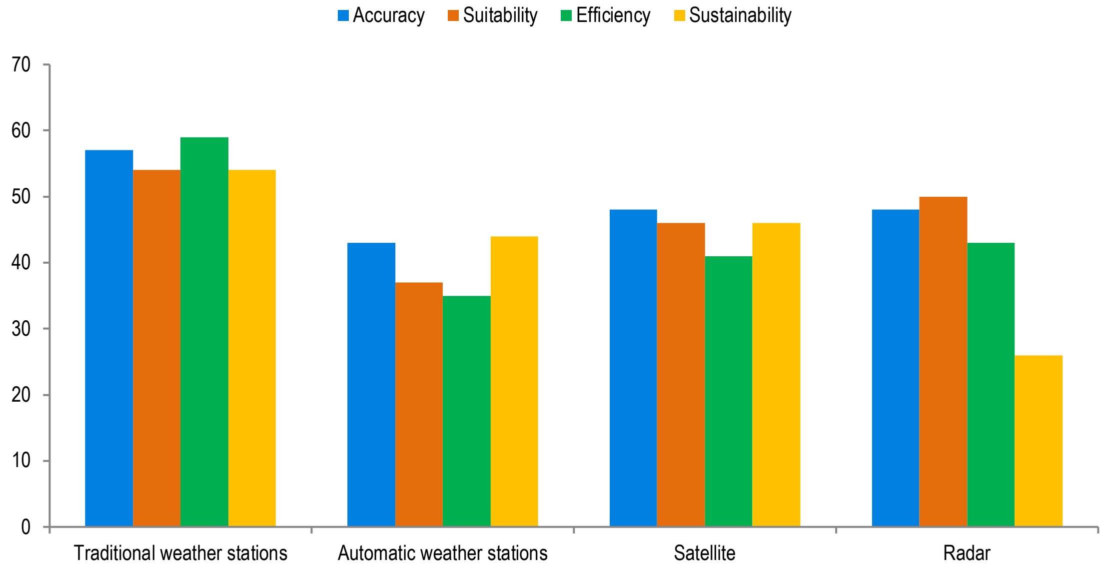
1 Generally, to meet commercial insurer and reinsurer requirements, ideally 20 to 30 years of daily, reliable weather observations are required with only a small percentage of the total dataset missing. The data need to be available at the level of disaggregation appropriate to the product and the set Unit Area of Insurance.

(...)	Information needs	Extension services	Finance / insurance	Input suppliers	Farmer organizations	Research institutes	NGO
	Crop storage facilities and participants		X	X	X		X
	Informal credit and savings club		X	X	X		X
	inputs prices		X	X	X		X
	Remunerative output markets		X	X	X		X
	Agricultural policies		X	X	X	X	X
Pests and diseases	Contagious disease of livestock	X		X	X	X	X
	outbreaks of animal disease	X	X	X	X	X	X
	Prevalent pests	X	X		X	X	X
	Prevalent diseases	X	X		X	X	X
	Incidence of pest	X	X		X	X	X
	Incidence of diseases	X	X		X	X	X
	Life cycle of pests	X			X	X	X
	Hosts for pest and diseases	X			X	X	X
	Animal welfare law	X		X	X	X	X
	Cost of pest control	X	X		X	X	X
	Cost of disease control	X	X		X	X	X

Source: Field survey

Majority of meso-level operators in the study indicated that traditional weather stations were more suitable, efficient and sustainable than radar[2], satellite[3], and automatic weather stations, reflecting traditional weather station is the most prevalent data method for agricultural risk management. Several extension workers have not yet been equipped with skills required to handle data from modern instruments such as satellite data and automatic weather stations. They are most familiar with working with data obtained from traditional weather. Data collection method for pests and diseases is still paper-based across Zambia's 109 districts. The prevalence of traditional methods in Zambia has implications for the skills and capacity of the meso-level operators as well as their judgment of other data methods

Figure A: Ratings of Weather Data Collection Methods (%)



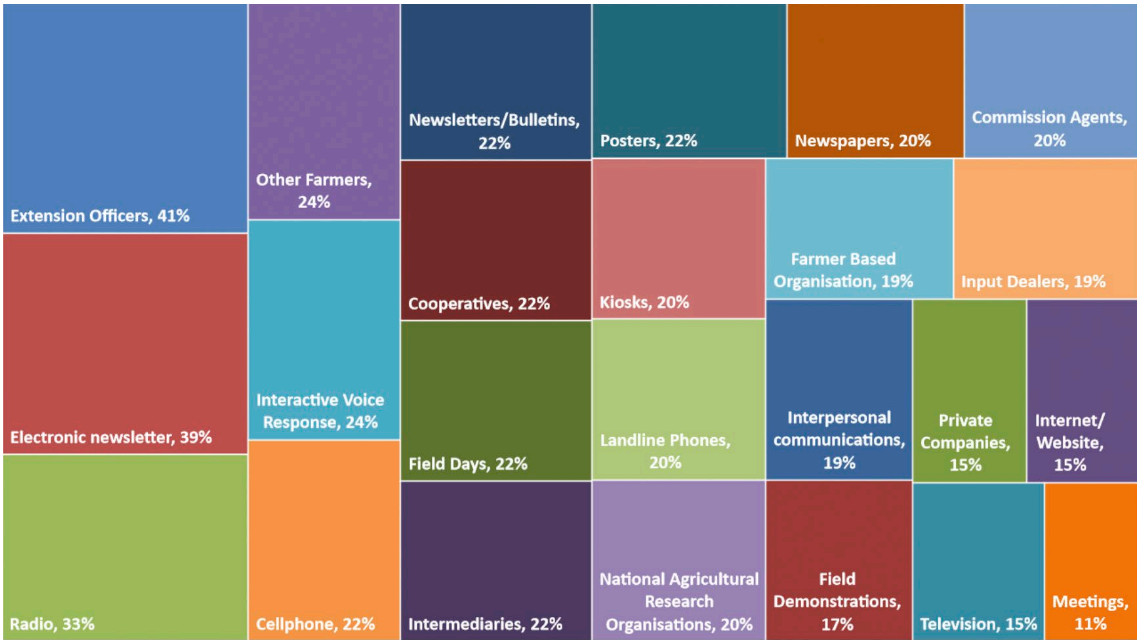
Source: Field survey

In terms of preparedness and response by meso-level operators in managing agricultural risks at the sector, local, sub-national and national levels, the study showed that preparedness at the sector level is highest with low percentages at national, sub-national levels and local level. Plans to improve pest and disease data collection, analysis and reporting, dissemination and communication include creating a web-based EWS or surveillance system where data will be entered from districts to simplify the work undertaken by National Livestock Epidemiology and Information Centre (NALEIC) to do the analysis and advise on response strategy. This is however challenging, due to the limited funding from the government. Data capture is not available in real time due to inadequate staffing capacity.

This study observed capacity gaps in the current agricultural information systems. Zambia Meteorological Department (ZMD) has inadequate capacity in terms of technologies for weather monitoring and technical skills for analysis and interpretation of weather data. The Ministry of Agriculture through the extension services has not been effective in pests and disease surveillance and agronomic advisories due to challenges of transportation facilities, poor road networks, inadequate funding and shortage of extension staff. There is a standardized data collection template with the Department of Agribusiness and Marketing of the MoA but the Market Development Officers from the Agricultural Market Information Center (AMIC) have received minimal training in the management and application of market information and data collection approaches. In addition, there is weak collaboration among key relevant ministries involved in data collection; monitoring and warning systems; analysis and reporting; and dissemination and communication, resulting in a range of weaknesses all along the supply chain for price information. These include irregular data collection and transmission, unreliable data, unstructured management that and lacks strategic oversight, and dissemination is entirely supply-driven.

Notes:
The survey indicates that 24 main information channels are used by the respondents' organizations. The top six channels for disseminating agricultural risk information and EWS channels are extension services with a score of 41 percent, electronic newsletter (39 percent), radio (33 percent), other farmers and interactive voice response (24 percent each), and cell phone (22 pecent).

Figure B: Preferred information dissemination channels used by meso-level operators (%)



Recommendations

Priority activities for targeted investment for improved agricultural risk management are outlined as follows:

i. Modernizing infrastructure for data collection and dissemination.

Investing in the modernization of infrastructure for data collection and dissemination will enable the timely collection of information and particularly from remote areas that are difficult to reach. It will also improve the dissemination channels which have proved challenging in the current systems. Upgrading the existing infrastructure and application of satellite data and Information and Communication Technology (ICT) will enable collection of precise weather data and measurement of weather related risks at specific locations. In addition, improving internet connectivity will improve access to information required to better manage agricultural risks.

ii. Enhancing technical skills and institutional capacity.

Investment for enhancing the technical capacity within key government agencies and departments will enable the delivery of quality, accurate and timely information. There is a need to strengthen the expertise within its management to include business development capabilities and public-private partnerships. As ZMD is the main provider of weather information and agro-meteorological information that gives an overview of the crop (maize) condition based on the crop stage and amount of rainfall, its institutional performance still needs to be enhanced through staff training, introducing business development experts, retraining, professional development and collaboration with development partners. On the other hand, Ministry of Agriculture needs to increase the number of extension officers, and deliver/provide regular trainings on pests and diseases data collection and dissemination. There is also a need to increase number of data analysts for pests and diseases at NALEIC. Community surveillance should also be encouraged for real-time monitoring of pests and disease outbreaks. In order for marketing information system to be effective there is need for regular trainings of staff responsible for market information on collection, processing and dissemination. Development partners should be encouraged to fund as well as give technical assistance.

iii. Establishing web-based Integrated Information Systems for Agricultural Risk Management and EWS.

Integrated information system will enable timely and cost-effective provision of information. Web-based integrated information systems are more reliable in providing data and enhancing access to information needed by farmers and meso-level operators, to better manage agricultural risks across the value chain. For instance, access to information about crop prices in different markets increases the bargaining power of farmers enabling them to boost incomes by 10-30 percent[4].

To estimate the value of the recommended actions in the investment plan, an economic analysis that estimates both costs and benefits has been undertaken. The costs of the investment plan per component is indicated in table below.

Table B: Costs for developing the Zambia integrated agricultural risk and early warning information system

Component	Description	Cost in US$
Component 1	Modernization of infrastructure for data collection and dissemination	2,827,500
Component 2	Enhancing technical skills and institutional capacity	5,710,000
Component 3	Establishing integrated system for agricultural risk management and EWS	5,775,00
Total Investment Cost		14,312,500

Two approaches were combined to estimate the benefits from the investment. The first is the benchmarking approach that was used to estimate the order-of-magnitude benefits of reducing damages from weather-related events resulting from the adoption of the integrated weather and market information services. The second approach is the benefit transfer approach that estimates benefits of improved ARM services. The benchmarking approach reveals that improved weather services will reduce economic losses in Zambia by US$51.6 million/year, corresponding to $3.7 million/year for the agricultural sector alone.

In addition, the benefits transfer analyses indicates that modernization of existing information systems infrastructure will lead to agricultural productivity increases ranging from US$5.4 million to US$26.9 million annually. Using a time horizon of 20 years and a 12 percent discount rate, the projected earnings generated by the investment exceeds the anticipated costs by $61.4 million. A cost-benefit ratio (BCR) of 3.7 indicates that every dollar invested in improving agricultural risk information will yield about 4 dollars, indicating that the investment is economically viable. Sensitivity analyses demonstrate the robustness of the investment to changes in discount rate and benefit rates, but the sustainability of the investment will largely depend on continuous support of the initial investment in terms of operations and maintenance costs, and skills development. Mainstreaming agricultural risk management into the agricultural planning framework and national budget is vital for enhancing the resilience of the agricultural sector in ZambiaCHAPTER ONE: Introduction and Context

4 https://www.weforum.org/agenda/2015/06/8-ways-africa-can-raise-farm-productivity-and-boost-growth/

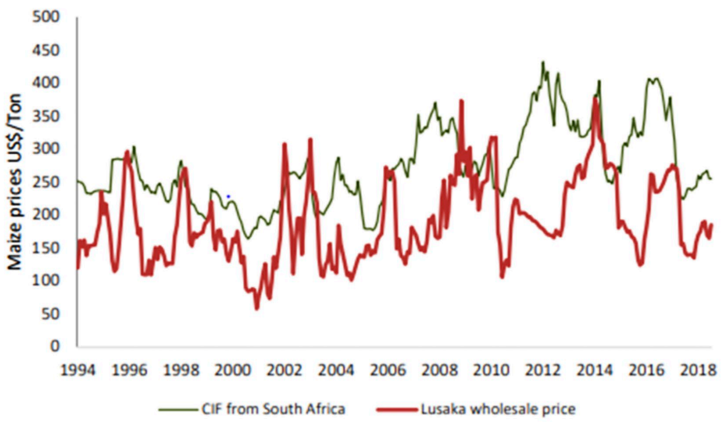
1. Introduction and context

Zambia's agricultural sector has experienced significant economic losses due to weather variability, pests and diseases, and price volatility. These risk events were a major factor contributing to the decline in agriculture's share of Zambia's gross domestic product (GDP), which fell from 8.2 percent during the period between 2011 and 2015, to 5.3 percent in 2015 itself, a year that saw a variety of such events, including El Niño and attacks of fall armyworms[5]. In addition, ad hoc, unforeseen changes in import or export restrictions, duties and other interventions have resulted in price volatility making it difficult for farmers to plan appropriately.

Agricultural risks in Zambia can be usefully classified into production, market, and enabling environment risks depending on whether the risk predominantly affects the immediate production environment, markets, or the broad institutional context in which commodities are produced and supplied. This report focuses on weather variability, pests and diseases, and price volatility (markets), and how they can be effectively limited through agricultural information systems tailored to the conditions prevailing in a country's agricultural sector. Weather variability, and pest and diseases risks have a direct, immediate impact on local agricultural production, but their effects are transmitted from the farm all along the supply chain. Price volatility in the agricultural sector on the other hand affects different actors in different ways, depending on where they are positioned on the supply chain. For example, a farmer's income is negatively affected by a sharp fall in producer prices, but a consumer sees lower food prices. A trader or a processor may lose out on a fall in retail prices or profit from an increase, depending on the timing of the price change. Although certain levels of intra- and inter-seasonal price volatility are acceptable in the market, it is the unpredictability of this volatility that presents a major price risk especially for smallholder farmers. Price volatility is a manifestation of supply shocks that affect food stocks leading to government measures such as trade restrictions that can in turn lead to extreme price shifts over and above what is expected and predictable, leading to huge unexpected losses. Additionally, sharp price drops negatively affect planting area and input investments, leading to yield drops and losses in production. Farmers plant a smaller area for the affected crop and reduce their level of investment in fertilizer and improved seed, thus reducing production of the crop the next season.

Figure 1 shows trends in Lusaka maize prices and import parity (CIF from South Africa). The large inter seasonal and intra seasonal price swings in the Lusaka maize prices could be a result of a number of factors including weather shocks but more significantly is a reflection of policy instability in comparison to South Africa which has limited interference in the maize sector. It is apparent that restrictive trade policies implemented by the Zambian Government over the years have not helped address price volatility contrary to popular views.

Figure 1: Lusaka Maize Prices vs. Import Parity Lusaka, Zambia

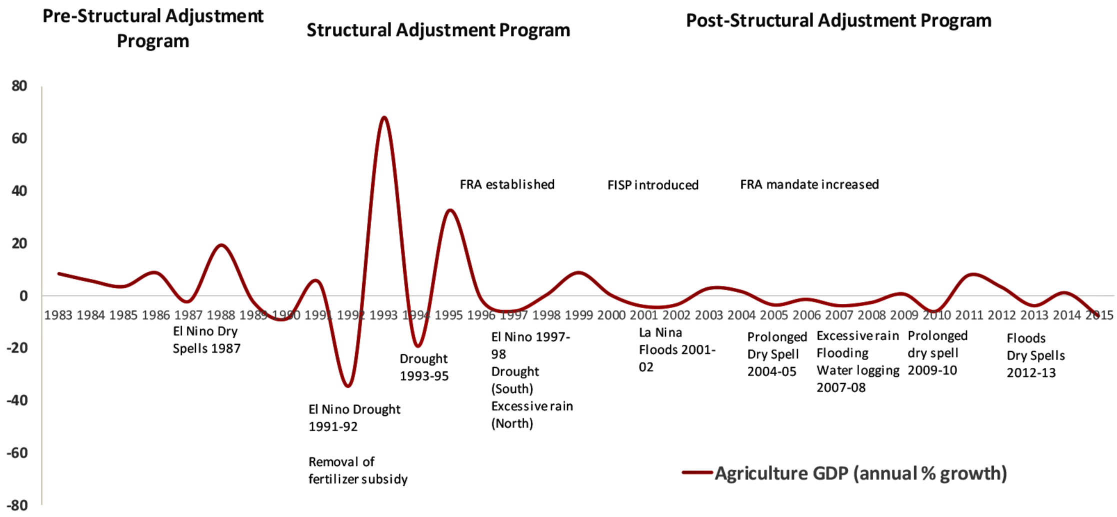


Source: MoA various years; GTAZ various years; SAFEX various years.

5 https://reliefweb.int/sites/reliefweb.int/files/resources/125784-WP-25-4-2018-9-34-36-ZambiaAgResilienceRiskMgtweb.pdf

A well-managed strategic grain reserve and price stabilization policy allowing for clear triggers for maize purchases and releases by Foreign Reserve Agency (FRA) needs to be formulated. This would allow normal seasonal price fluctuations to take place, which is a key ingredient for encouraging private sector investments into the agricultural sector. The failure to have clearly established price stabilization policy causes panic and knee-jerk policies with few winners and many losers.

Figure 2: Major Agricultural Risks in Zambia



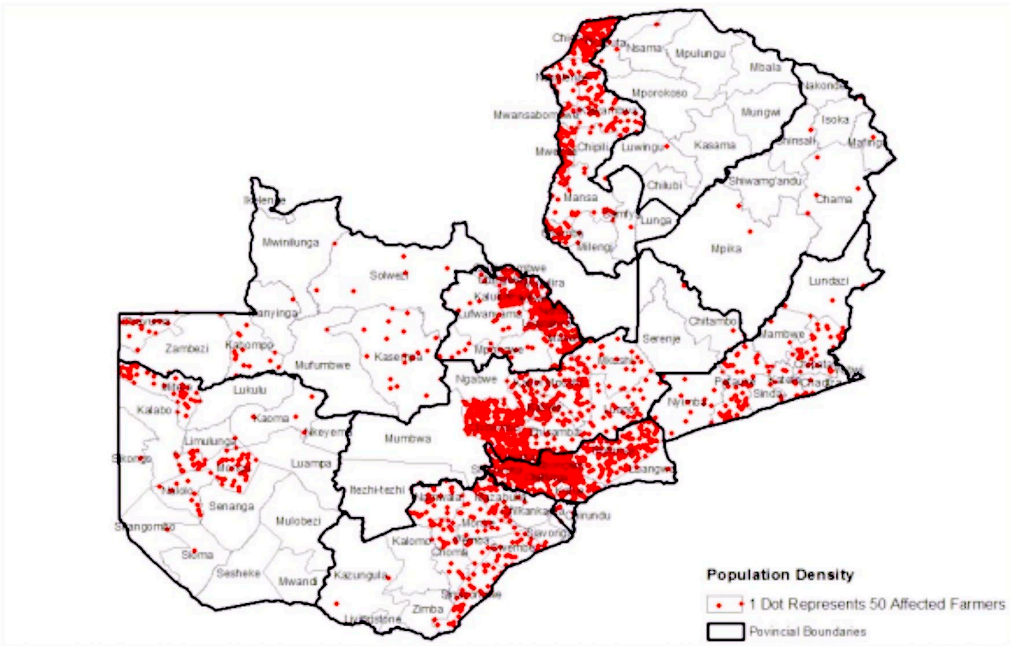
Source: World Bank 2017

In a country that largely relies on rainfed agriculture, unpredictable weather patterns over the past ten years have only exacerbated the issue. According to World Bank 2017, between 1981/82 and 2016/17, Zambia experienced two severe droughts and five droughts in which more than 40 percent of the country was affected. Overall, severe droughts occur 1 in 20 years, whereas localized droughts occur 1 in 5 years. The major drought incidences are linked to El Niño events of 1991/92, 1993/95, and 2014/15 as shown in figure 1 above. This has impacted both the producers and consumers and the various players in the agriculture value chain. Equipping relevant stakeholders including researchers, government institutions, private sector players and development agencies with agricultural information will inform better decision making.

Fall armyworm (*Spodoptera frugiperda*) and maize stalk borer (Busseola fusca) are among the key pests affecting crop yields in Zambia, while cassava mosaic disease is the most significant risk to the cassava value chain in Zambia (World Bank, 2017). A fall armyworm outbreak that started in Nigeria in early 2016 swept across Africa in 2017 has rapidly continued and now 44 countries in Africa are affected. There are no reports from North Africa, but FAW has reached the Indian Ocean islands including Madagascar. Environmental suitability modeling suggests almost all areas suitable for FAW in sub-Saharan Africa are now infested. Household surveys conducted by CABI with the Zambia Agricultural Research Institute (ZARI) indicate that 98 percent of farmers reported maize to be affected, but only 2-4% reported damage to Napier grass, sorghum or millet. The average maize loss reported by farmers in Zambia was 35%, indicating that several parts of Zambia are highly suitable for FAW.[6] Extrapolating these losses nationally gives an estimate of US$159m in losses to FAW in Zambia. The Provinces with the worst damage included Central, Copperbelt, Eastern, Luapula and Lusaka Provinces as shown in figure 3 below.

6 https://www.invasive-species.org/wp-content/uploads/sites/2/2019/02/FAW-Evidence-Note-October-2018.pdf

Figure 3: Population density of farmers impacted by fall army worm, January 2017



Source: Government of the republic of Zambia, February 2017

Zambia's agricultural price risks emanate from production risks and exacerbated by excessive market interventions by the government. The interventions are mainly short-term measures aimed at maintaining stock levels within the country. This is more so for maize compared with any other crop and they include export bans/restrictions, strategic stockpiling, and price controls. These short-term measures are popularly used to mitigate against production-related risks but end up worsening the situation by increasing price volatility in the market (Chapoto and Jayne 2009). Reliable information on grains stocks (private and public storage), production, trade, and consumption, could greatly help the government in food security policies.

1.1. The Importance of Information in Managing Agricultural Risks

Agricultural information is important to all value chain actors and flows in two directions: markets inform producers of price, quantity and quality needs, product handling and technology options, while producers inform processors and markets on production quantities, locations, timing and production issues. In a value chain, processors and marketing agents may provide producers with finance, inputs and training in technologies of agricultural production.[7] Through agricultural information farmers can adopt new technologies or farming systems, know when to plant and harvest, which crop to produce and which animal to rear and where to sell. Agricultural information enables farmers to know where to acquire bank loans and other farming inputs, as well as methods to control pests and diseases. Such information will consequently increase agricultural production and resilience, including improving the standard of living of farmers

7 https://www.devex.com/news/agricultural-value-chains-a-game-changer-for-small-holders-83981

Timely access to information is a crucial ex-ante risk mitigation instrument to manage agricultural risks. Early Warning Systems (EWS) and complementary agricultural information systems, are important tools for improving monitoring and responses to foreseen and imminent weather, pests and adverse price events. This is especially relevant for Zambia given its exposure to extreme weather events including El Niño, the recent outbreaks of fall armyworm, and the highly unpredictable output prices. Improving agricultural risk information and early warning systems (EWS) will enhance the capacity of national agencies to deliver early warnings in a timely and effective manner. Information is expected to be relevant to crops and livestock, and the principal end-users to reach farmers should be meso-level stakeholders in the agricultural value chain, hereafter referred to as meso-level operators. Meso-level operators are those actors active along agricultural supply chains that are directly in contact with farmers. They include public and private extension services providers, financial service providers including insurance companies, input providers, , farmer organizations and cooperatives, local governments, cross-border traders association; and grain millers association among others. Agricultural meso-level operators represent an optimal channel to reach large amount of smallholder farmers and could result in better management of agricultural risks along the supply chains.

Early warning and other forms of decision support information already exist in Zambia. The ZMD is charged with weather observation, analysis and prediction and agro-meteorological information that gives an overview of the main crops (e.g. maize and sorghum) condition based on the crop stage and amount of rainfall. Similarly, Zambia Agricultural Research Institute (ZARI), research universities (e.g University of Zambia School of Agriculture), and extension services typically inform of best practices in crop selection, production techniques, input use, pest management, global commodity trends, and other topics critical to the success of smallholder farmers. International organizations also generate early warning and decision support information. USAID's Famine Early Warning System[8] provides information for governments to manage food security risk, for example. A similar system at FAO helps to manage food security risk—the Global Information and Early Warning System[9]. One difficulty, however, has been to collect and process accurate, timely, localised and reliable agricultural information .Another challenge has been to transmit the information to rural populations in poorly connected areas in cost-effective ways.

1.2. Objectives and Scope of Report

The objective of the study is to develop recommendations and a corresponding investment plan for early warning and information system(s) to help meso-level operators in agriculture and smallholder farmers better manage risks related to weather variability, pests and diseases, and price volatility. It reviews existing information systems and proposes solutions to converge them into an integrated agricultural risk management system. The report focuses on producing relevant agricultural risk and early warning information and making them available and accessible in a timely and cost-effective manner through efficient dissemination channels. An investment plan for developing such an integrated information platform completes the report.

8 http://www.fews.net
9 http://www.fao.org/giews/english/index.htm

2. Agricultural risk and early warning information for meso-level operators

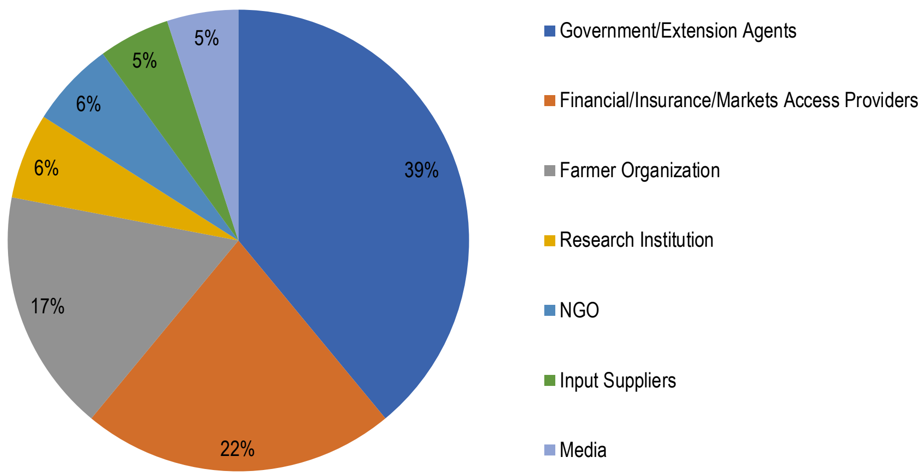
A number of meso-level operators were purposively sampled to obtain information on access to agricultural risk information for decision making in Zambia. Of this, 18 meso-level-operators responded to the online survey questionnaire and whose responses are analyzed in this chapter. The respondents included government and non-government agencies and users of agricultural risk information. Respondents included District Agricultural Coordinating Officers, Agricultural Extensionists, Information Officers, and Crops and Livestock Production Officers - in Gwembe, Chipata and Lusaka Districts, Zambia Meteorological Department (ZMD), Disaster Mitigation and Management Unit (DMMU), Water Resources Management Authority (WARMA), Zambia Agriculture Research Institute (ZARI). Other respondents include officials of the following organizations: Cotton Board of Zambia, Zambia National Commercial Bank (ZANACO), Zambia Commodity Exchange (ZAMACE), and Zambia Information and Communications Technology Authority (ZICTA). Modern Bazaar Agrodealer, Tobacco Board of Zambia (TBZ), Zambia Agriculture Consultative Forum, Heifer International, and Mayfair Insurance.

The responses from meso-level operators were supplemented by feedbacks from 35 other informants that participated in interviews in Lusaka and 4 focus group discussions (FGDs) in Gwembe and Chipata districts. Information from official documents was also reviewed to gain an improved understanding of agricultural risk and early warning information needs for meso-level operators in Zambia.

2.1. Type of the meso-level operators

Of the 18 meso-level organizations who responded to the online survey, 7 were from the Government/ extension service providers (1 from Gwembe district, 1 from Chipata district and 5 from Lusaka district), 3 from farmer organizations, 1 from the research institution, 2 from agricultural insurance providers/ intermediary, 2 from input suppliers. 1 from banking sector/agricultural financing, 1 from commodity exchange, 1 from communication/media and 1 from NGO/Development agency.Government/Extension services providers accounted for 39 percent, financial services including insurance companies and those offering market access accounted for 22 percent, Farmer Organizations accounted for 17 percent, research institution accounted for 6 percent and input suppliers, media and NGOs each accounted for 5 percent respectively of the respondents (Figure 4).

Figure 4: Nature of the Meso-level Operators responding to online survey



Source: Field surveys

Box 1: The Meso-level operators at a glance

Government/extension services providers [National Livestock Epidemiology Centre under Ministry of Fisheries and Livestock; Ministry of Agriculture, Zambia Agriculture Research Institute; Water Resources Management Authority; Zambia Meteorological Department; and Disaster Management and Mitigation Unit]. This refers to agricultural intervention by the government to provide information and advice on crops and livestock, and fisheries with the intention of promoting knowledge, attitudes, skills to farmers to increase the total yield and quality of their crops.

Financial service providers. This group focused on financial service providers which give smallholder farmers access to financial services. While not a means to an end, access to financial products and services such as credit, savings, and insurance (discussed below) are critical to provide funds for farm investments in productivity, improve post-harvest practices, smooth household cash flow, enable better access to markets and promote better management of risks. Access to finance can also play an important role in climate adaptation and increase the resilience of agriculture to climate change, thus contributing to longer term food security. Access to a comprehensive range of financial services is a significant challenge for smallholders, who constitute the vast majority of farmers in developing countries.

Insurance providers refers to those institutions that provide insurance services to support farmers in case of risks such as drought. It does not include other meso-level institutions that are more often than not part of the distribution of products or payouts e.g. MFIs, input suppliers, farmers' organizations. Insurance products for managing agricultural risk include products focusing on climate related aspects of production risk., There are synergies between insurance and credit. Risks related to buying good-quality seed or fertilizer could be managed if the input credit is linked to index insurance. Farmers may also be more willing to take on loans and financial service providers more willing to give them. This gives farmers the capacity and confidence to invest in new technologies. It also can help protect any income gains and savings.

Market access providers (Zambia Commodity Exchange and NWK Agri-Services Limited). Smallholder farmers often lack access to profitable, value-added markets. In the absence of critical supporting functions such as infrastructure and service provision, farmers struggle to shift from subsistence and barter to more productive forms of exchange. Market access providers train farmers how to handle their crops after harvest to minimize losses and to work together to meet market requirements and participate in efficient markets.

Farmer organizations and cooperatives Farmers' voice cannot be obtained without farmers' organizations. To engage in any sensible dialogue with the rest of society, farmers need their representative organizations, structured from grassroots to the international level, as their legitimate voice. These organizations are inclusive of the poor and are charged with the purpose of becoming a market outlet for smallholder farmers. They also have an influential role in shaping policy, negotiating directly on behalf of the farmers.

Input providers (NWK Agri-Services Limited and Modern Bazaar, Chipata): These entities play a big role in agricultural development, as they give farmers access to inputs, and market information to farmers. They are also a link between Government and the farmer. In working with the farmers, Government also forges a link with the input providers as part of the chain that contributes to the affordable production of farm produce such as in the FISP.

Development programmes and NGOs (Heifer International, Enhanced-Smallholder Agribusiness Promotion Programme- IFAD) These entities are mainly knowledge brokers and intermediaries They package research information for delivery to intermediate users and are mandated to transmit feedback on farmer needs to the researcher. They also have a role in influencing framework conditions for individuals and households to make more sustainable consumption decisions e.g. by providing independent and credible information on agricultural risk information, their contents and how to use them. They are also increasingly involved in disseminating information through financial rating and ranking schemes for the benefit of stakeholders. (…)

(...)
Media (Zambia Information and Communications Technology Authority). These enterprises provide an increasing menu of agricultural information services delivered by print, radio, and television, plus a host of new electronic media and have a wide reach.

2.2. Meso-level operators' information needs

Information is the most critical requirement for effective risk management (mitigation-transfer-coping), and farmers and other players in the agricultural value chain need a variety of specific information to make choices to manage risk. Information needs vary among meso-level operators. Two types of information can help inform decision making for risk management t. The first is early warnings about the likely occurrence of inclement weather, pest and disease outbreaks, and market price volatility. The second is advisory information to help stakeholders (including farmers) decide upon their strategies to manage risks optimally or to respond adequately to early warnings. The information can be provided in form of recommendations, agronomic options, and alerts.

With access to quality and timely data, meso-level operators will be adequately equipped with information that will help them to improve their risk management strategies and more importantly assist farmers to help them make better agricultural risk management decisions. Improving access to agricultural risk information needs to be addressed. For instance, insurance providers as a meso-level operator will require quality and accessible agricultural and weather data to help better design and price their transfer products and potentially scale-up agricultural insurance. This information is also important for credit providers/financial institutions in identifying their risk in their portfolio and taking financial and nonfinancial actions to reduce the risk in their lending operations to agriculture.

Agricultural risk information needs for meso-level operators based on responses from online questionnaire, key informants and interviews in relation to weather, pests and diseases and prices is presented in Table 1. Extension Service providers require most information on weather and pests and diseases, they are more focused on production information; Insurers and insurance intermediaries also require similar information as extension service providers and time series of yields and rainfall in different locations for different crops, in order to design insurance products, trigger payments, and monitor the contracts. Finance and market access providers require historical time series data of rainfall, yields, prices, for all crops. Farmer organizations and NGOs require all information on weather, market and pests and diseases but more of market information in comparison to the others. There requirement vary across the production cycle depending on their interests, crops or creation of market opportunities Research institutions require more of yields, weather and pests and diseases information. They require more of pre cultivation and cultivation information to advise the government on policies and related issues and farmers on agronomic needs.

Table 1: Meso-level operators information needs in relation to weather, price and pest and diseases

	Information needs	Extension services	Finance/ insurance	Input suppliers	Farmer organizations	Research institutes	NGO
Weather	Accurate weather information	X	X		X		X
	Agroweather information	X		X	X		X
	Timely weather information	X	X	X	X		X
	Rainfall	X	X		X	X	X
							(...)

(...)	Information needs	Extension services	Finance/ insurance	Input suppliers	Farmer organizations	Research institutes	NGO
	Flood	X	X		X	X	X
	Temperature variations	X	X		X		X
Market	Availability of agricultural inputs and services		X	X	X		X
	Access to quality inputs		X	X	X	X	X
	Marketing subsidies,		X	X	X		X
	Export ban		X	X	X		X
	Agricultural insurance participants		X	X	X		X
	Agricultural markets participants		X	X	X		X
	Crop storage facilities and particpants		X	X	X		X
	Informal credit and savings club		X	X	X		X
	inputs prices		X	X	X		X
	Remunerative output markets		X	X	X		X
	Agricultural policies		X	X	X	X	X
Pests and diseases	Contagious disease of livestock	X		X	X	X	X
	outbreaks of animal disease	X	X	X	X	X	X
	Prevalent pests	X	X		X	X	X
	Prevalent diseases	X	X		X	X	X
	Incidence of pest	X	X		X	X	X
	Incidence of diseases	X	X		X	X	X
	Life cycle of pests	X			X	X	X
	Hosts for pest and diseases	X			X	X	X
	Animal welfare law	X		X	X	X	X
	Cost of pest control	X	X		X	X	X
	Cost of disease control	X	X		X	X	X

Source: Field survey

2.3. Data methods for agricultural risk management

Meso-level operators were asked to rank weather data methods used in their organizations based on accuracy, suitability, efficiency, and sustainability on a scale ranging from 1 (lowest) to 3 (highest). Four methods for weather data collection were identified, and their characteristics are summarized in Box 2. Accuracy in this context refers to how exact the analysis and predictions are to stakeholders; Suitability refers to relevance to users for whom the information is intended in terms of what type of risk, crops or livestock, where and under what conditions they can be used[10]. Efficiency connotes the capabilities of the data collection method to provide timely information in a cost-effective manner; while sustainability implies its affordability in terms of maintenance over a period, typically beyond donor funding. The scores for each respondent was summed across the meso-level operators and expressed as percent of the maximum score possible (Figure 5).

Box 2: Weather data collection methods

Traditional: In recent years, not only the quantity of rain that falls, but the timing at which it does so have become of interest. Weighing lysimeters are used to directly measure the loss of moisture from both plants and soil. These are complex devices to operate and maintain and are usually found only in agricultural research institutes and universities. As a substitute, agro-meteorologists and agricultural engineers have devised what is termed (in the United States) the "Class A Evaporation Station." Traditional Weather Stations are characterized by the need for trained humans to read, record, and send in the collected data for others to scrutinize in a quality assurance/quality control (QC/QA) process, and then analyze for operational use. In many cases, instrument components are fragile and require careful handling. Often, routine resupply of expendables is necessary. Most such instruments require regular maintenance and calibration.

Automatic weather stations: Automatic weather stations are most powerful when operated in a network across a region to provide weather observations. Advantages over traditional manual systems are as follows: standardization of observations, both in time and quality, greater reliability, real-time continuous measuring of parameters on a 24/7 basis, improved accuracy (eliminates reading errors, subjectivity), collection of data in a greater volume, for example, one-minute or five-minute data as opposed to hourly or once per day, automatic adjustment of sampling intervals of different parameters in response to changing weather events, automatic QC/QA (during collection and reporting stages, including automatic alerts to users and maintenance personnel when errors are detected, automatic message generation and transmission, including alerts when critical thresholds are crossed, automatic data archiving, access to data, both real time and archived, locally or remotely, and collection of data in remote orharsh, climates.

Automated observations also bring their own set of disadvantages. There is a high initial cost of instrumentation and associated equipment and then ongoing costs of operation, such as for maintenance, electrical power, communications, security, and so on, it is not possible to observe all desirable parameters automatically; at key locations, it may be necessary to augment automatic observations with a human observer to obtain information such as cloud coverage, cloud hours and cloud types, if solar panels are used to power a station, this may limit the amount and type of instrumentation, local computing, and telecommunication equipment that can be used, final quality control is best carried out by a staff of trained operators working on a 24/7 basis, the high volume of data generated requires the development of a data archival system that can be costly in its own right, which will require periodic forward migration as software changes, and routine preventative and as-required corrective maintenance, together with periodic sensor calibrations, require a staff of trained maintenance technicians.

Satellite: These provide remotely sensed area measurements for estimating aspects such as rainfall, temperature, evapotranspiration, and vegetation health. There are two main types of remote sensing systems – "passive" sensors and "active" sensors. Passive sensors measure either sunlight being reflected (visual and near-infrared light) or radiation being emitted (thermal or microwave) from the earth's surface. Like our eyes, these sensors operate largely within the optical spectrum, producing images that are recognizable

10 http://p4arm.org/app/uploads/2016/05/PARM_ARM-Tools-Elearning_Gunjal_May2016.pdf

and easily interpreted. Passive sensors, however, do not provide information in the case of cloud coverage. Active sensors are independent from the sun's illumination because they have their own energy source (usually microwave) directed towards the earth's surface. Radio detection and ranging (RADAR), for example, sends microwave radiation at a specific polarization (horizontal or vertical), which is backscattered from (bounced off) the earth's surface and recorded again by the sensor.

Different types of information products are derived from these remote sensing systems. Some of the most widely used remotely sensed products for agricultural monitoring are rainfall estimates, soil moisture, evapotranspiration and vegetation indices. Satellite-based rainfall or soil moisture estimates may provide information on the climatic conditions that influence crop growth. Vegetation Indices such as Normalized Difference Vegetation Indices (NDVI) or fraction of Absorbed Photosynthetically Active Radiation (fAPAR) make it possible to follow crop growth and development during the season. Vegetation indices can also be used to distinguish between different land cover types or, in some cases, even different crop types. Identifying land cover, and possibly crop types, is important to create masks that act as inputs to remote sensing interpretation. Evapotranspiration compares the crop's water demand with the available soil moisture. Directly or indirectly, these products can all provide indications on crop health and productivity, and they can aid in identifying crops affected by weather-related damage (e.g. lack of rainfall or flooding) or by pests or diseases. Identifying land cover, and possibly crop types, is important in creating masks that act as inputs to remote sensing interpretation

Source: World Bank 2015 and IFAD 2017

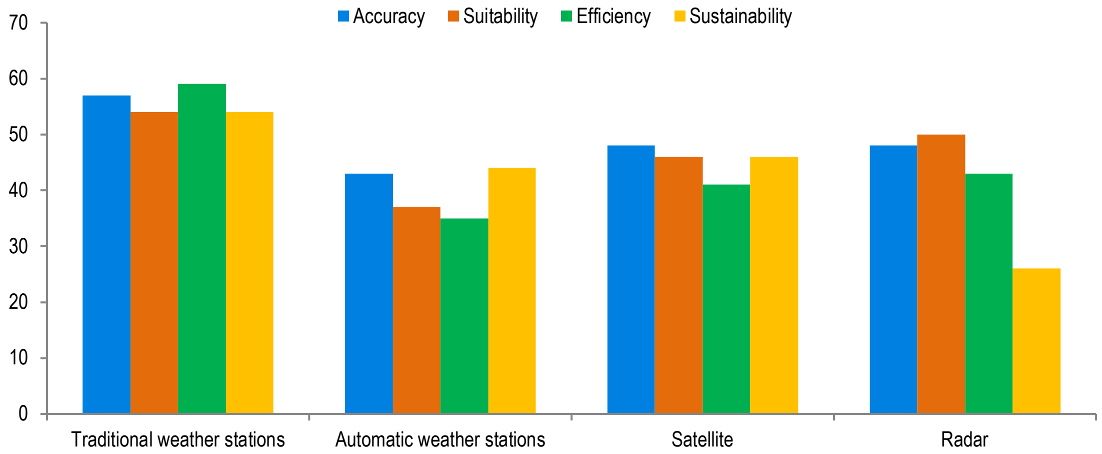
The respondents rated traditional weather stations highest across the four evaluation criteria (accuracy, suitability, efficiency and sustainability on a scale ranging from 1 (lowest) to 3 (highest). This could have been due to the fact that not all the respondents are all familiar with and have used other types of data sources. Traditional weather stations were rated as the most accurate weather information and EWS source in the opinion of the respondents (57 percent), while automatic weather station was rated the least (42 percent). Weather stations, automated or manual, physically measure weather metrics such as rainfall, wind speed, and temperature. Weather station networks are generally seen as trustworthy sources of information among local farmers but does not cover the country's entire agricultural area. Given the land area of Zambia and that the population is well dispersed, it might not always make economic sense to cover every area, considering also that maintenance is a key issue. Moreover, typical applications such as risk assessment or weather index design requires about two decades of historical weather data to produce accurate models, but weather station data often have gaps due to problems with the collection or storage of data.

Satellites were rated the next most accurate at 48 percent. Satellites remotely estimate factors such as rainfall, evapotranspiration (transfer of water from land surface to the atmosphere through evaporation and plant transpiration), vegetation cover, and wind speed. Historical data from satellites are much more consistent than data from weather stations, and ongoing data are also reliably available. But drawbacks can include the technical skills required to interpret the data and develop it into risk management end-uses. As discussed previously, often a combination of ground data is still needed for tools based on satellite data.

Data capturing methods for agricultural risk management were measured in terms of suitability, efficiency and sustainability. In all of these indicators, meso-level operators were asked to indicate the level at which their data capturing methods for risk management meets international standards on a scale of 1 (low) to 3 (high). These ratings are based on what methods are operational in the respective organization of each of the meso-level operators. Suitability of the methods was rated in the order traditional weather stations (54 percent), followed by radar (50 percent), satellite (46 percent) and automatic weather stations (37 percent). Efficiency ratings of the methods follow the same pattern as accuracy, with traditional methods rated as most efficient (59 percent), followed by radar (43 percent), satellite (41 percent), automatic weather stations (35 percent). The trends of rating by meso-level operators for suitability and efficiency is a reflection that traditional weather station is the most prevalent data method for capturing weather data for purposes of agricultural risk management. This prevalent method also has implication for the skills and capacity of the meso-level operators as well as their judgment of other data methods, however many authors have established that satellite and automatic weather stations are much efficient, sustainable and suitable for agricultural risk management although with a high capital outlay for equipment and manpower to achieve the required density for accurate data (Box 2.2). Traditional weather station was scored 54 percent in terms of sustainability, followed by satellite (46 percent), automatic weather station (44 percent), and radar (26 percent).

Sustainability of most initiatives supporting information systems has been an issue. Most have come to an end after funding of the donor supported projects has come to an end. In addition, most of the donor support is on pilot basis reaching only specific districts. This has an impact on the information collected as it only covers part of the country. This has compromised the quality of the data. The data has varied over time, and there is limited district coverage, and the target data such as commodities, level, and districts covered are inconsistent over time. With such inconsistences, the system clearly does not provide the timely, agriculture information (production, marketing, prices, weather risks) that the end users and policy makers require. Lack of coordination among various units and data management are other challenges

Figure 5: Ratings of Weather Data Collection Methods (%)



Source: Field survey

2.3.1. Data collection method for pests and diseases

National Livestock Epidemiology and Information Centre (NALEIC), EWS is still paper-based, collecting routine surveillance data monthly and active surveillance data on disease outbreak. The district officers (from 109 districts at the time of the study and currently there are 117 districts) send this information to the Director and to NALEIC at national level where the database is managed. With this information NALEIC can do data analysis, (produces graphs, maps etc.) and generate reports.

However, the biggest challenge with this data is that there are gaps in the current knowledge on pests and diseases, and where there is, it is not real time to inform the end users and the policy makers due to inadequate staffing at NALEIC which makes the data cleaning and verification impossible. Streamlining and increasing data collection efforts will allow response strategies to be science-based.

The Centre for Agricultural Bioscience International (CABI) with the support of International Partnerships from the United Kingdom (UK) established a €6.3 million state-of-the-art risk information service center to strengthen the resilience of Zambian smallholder farmers to pests and crop diseases such as fall armyworm. This is an intervention that supports the needs of farmers in handling crop pests. This is after 2016 where more than 172 000 hectares of maize across all 10 provinces in Zambia were ravaged by armyworms. CABI, in collaboration with the ZARI, trained 300 extension officers and equipped them with pest-related information with the right information disseminated, crops can be protected leading to increasing smallholder farmers' crop production and contribute to Zambia's food security as crop losses will be minimized.

2.3.2. Data collection methods for market variables

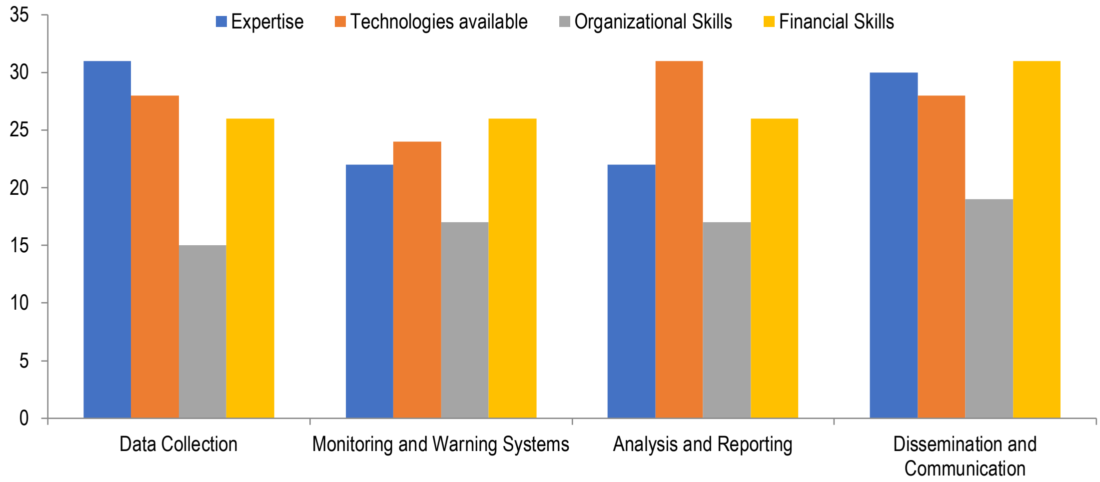
AMIC headquarters collects weekly retail and wholesale prices for a range of commodities from the ten provincial HQ districts. The other districts are encouraged to collect similar information. In principle, AMIC covers retail, wholesale, and farm gate prices, and updates weights and unit measurement information at each marketing level. A wide range of commodities have been requested and suggested by various stakeholders. AMIC has tried to meet these requests by piloting regionally-specific data collection requirements, such as prices for livestock, seasonal fruits, and fish. In addition, reviews of AMIC consistently recommend that it coordinate with other agencies to collect proxy marketing and transport costs, commodity stock levels, crop production forecasts, regional supply and demand trends, and prevailing international prices. Data collection methods for market variable is still done manually through interviews and the viability of the collection process depends on reciprocity between price collectors and traders.

Data collection and transmission is therefore quite irregular and unreliable, data management is unstructured and lacks strategic oversight, and dissemination is entirely supply-driven. AMIC should develop an integrated system that will help conduct regular and accurate data collection for a small set of important regional, and district markets for qualitative information, and conducting analysis about market trends and marketing margins and seek to disseminate this information regularly and broadly.

2.4. Capacities for agricultural risk analysis and management

Meso-level operators were asked to rate the capacities for agricultural risk information and early warning information management within their organizations on a scale ranging from 1 (lowest) to 3 (highest). The four types of capacity assessed were technical expertise for data collection; availability of technological infrastructure for modernized agricultural risk analysis and management; organizational skills for coordination and dissemination of information across key stakeholders; and financial management skills for ensuring funds are well managed for purposes for which they are allocated. The respondents rated the four functions across four components of agricultural risk management, namely data collection; monitoring and warning systems; analysis and reporting; and dissemination and communication. The scores for each respondent was summed across the meso-level operators and expressed as percent of the maximum score possible (**Figure 6**).

Figure 6: Capacities for agricultural risk information management (%)



Source: Field survey

The results show that expertise, technologies available, organizational skills and financial management skills for agricultural risk information management are all below 40 percent. Organizational skills were rated the least across the functions ranging from 15 percent for data collection to 19 percent for dissemination and communication.

Expertise: Respondents scored expertise for data collection at 31 percent, capacity for analysis and reporting at 22 percent, expertise for monitoring and warning systems at 22 percent, and expertise for dissemination and communication at 30 percent.

Technologies: Respondents scored capacity of available technologies for data collection at 28 percent, capacity of technologies available for analyzing and report at 31 percent, capacity of the available technologies for monitoring and warning systems was scored at 24 percent and capacity of available technologies for effective dissemination and communication at 28 percent.

Organizational skills: Capacity of the organization to analyze and report was scored 17 percent, capacity of the organizations to conduct monitoring and warnings was scored 17 percent and capacity to disseminate and communicate the agricultural risk information was scored 19 percent.

Financial management skills: Respondents scored financial management skills for data collection, analysis and reporting, monitoring and warnings within the organizations at 26 percent each. Financial management skills for dissemination and communication was scored 31 percent.

The impacts of the skills gap on information for managing weather variability, pests and diseases, and price volatility are discussed further below.

2.4.1. Capacity gap in weather monitoring

ZMD has huge gaps in the technical staff, and yet analysis and interpretation of weather data requires highly skilled staff. Satellite information systems that can generate weather information are seldom used at ZMD. According to the survey, there are inadequate automatic weather stations. There are meteorological data gaps for accurate analysis leading to poor data quality and lack of access to timely information with one of the reasons being that most of the farmers in the Ministries database do not have phones for short message service. Agricultural risk information is not downscaled in a form that is useful to the end users and decision maker. Another challenge is in matching decision-making needs to the available information. Weather information is not single-sourced, but instead is produced in a wide variety of formats and at multiple scales (for length of time and spatial coverage). Decision makers cannot always get the information they need, when they need it, or covering the areas of interest to them.

There is need for investment in modern methods (e.g satellite-based systems) for collecting, analyzing and disseminating data. For instance, investing in remote sensing equipment to enable collection of data from all points across the country; Investment in technical and analytical skills in agricultural risk information for producers to enable the downscaling of data and information into more user-friendly formats; development of feedback mechanisms; and Improvement of infrastructure such as satellite weather information, rain gauge stations, information centres, upgrading of more automatic weather and rainfall stations, equipping gauge readers with phones, and upgrading software for forecast and agrometeorological analysis.

ZMD works with development partners on climate information and EWS, an example is with funding from the Global Environment Facility Least Developed Countries Fund, United Nations Development Programme (UNDP) worked with the met department and district agriculture officers through the Climate Information and Early Warning Systems Project to notify farmers before planting time that the season would be dry, and advised them to substitute their regular crops with varieties that required less water. The sustainability of these projects is a challenge beyond the project life because of lack of adequate funding.

Box 3: Capacity gap at ministry of agriculture, Gwembe district

Gwembe District is located in Southern Province of Zambia. ZMD conducts meetings through camp officers and farmers are informed of weather patterns through these meetings. There is only one Automated Weather Station (AWS) in Munyumbwe in Gwembe District. The rest of the camps have rain gauges. ZMD also sends daily and weekly updates through the internet, although the message is quite generic. ZMD works in close collaboration with other line ministries like the Ministry of Agriculture (MoA) which is better staffed than ZMD, 15 agricultural camps are manned by officers that cover over 1000 farmers, however, coordination is a challenge in this case. In the case of ZMD, there are only 2 veterinary assistants out of 9 camps. The MoA also sends information to farmers through headmen. The information is not timely, not tailored to the farmers needs and there is poor road network. Community Development Office give advisories to farmers through the District Agricultural Coordinating Officer.

2.4.2. Capacity gap in pests and diseases surveillance

The Southern Africa Development Community (SADC) efforts for the management of Transboundary Pests and Diseases (TBPD) include several initiatives such as the Migratory Pest policy, Sanitary and Phytosanitary (SPS) Annex to trade protocol, Fruit fly implementation strategy among other collaborative effort in partnership with FAO. The effective implementation of these initiatives is constrained by low participation of member states in regional plant health forums, lack of a regional pest reporting mechanism to alert member states of eminent threats since the regional pest database (ICOSAM) platform is adjunct and limited resources allocated

for plant health issues. Gaps in the implementation of International Standards for Phytosanitary Measures (ISPMs) and regional obligations also contribute to information and surveillance challenges.[11]

In Zambia, information and surveillance systems are relatively weak. Timely access to pest information to guide decision making is hindered by inadequate diagnostic capacities and inter-sectoral information sharing, sub-optimal operation of national enquiry points and weak information management systems. For example, at the Ministry of Livestock and Fisheries data capture is not real time due to inadequate staffing and the available laboratories do not have capacity to serotype for Foot and Mouth Disease (FMD) vaccines. The ministry sends samples to South Africa or Botswana for laboratory analyses. Disseminating agricultural information to the large, widely isolated rural population of Zambia has not been easy due to inadequate means of transport, poor road networks, inadequate funding, and shortage of extension staff.

Ministry of Fisheries and Livestock (MFL) plans to improve pest and disease data collection, analysis and reporting, dissemination and communication and to create a web-based EWS or surveillance system where data will be entered from districts to make it easy for NALEIC to do the analysis and to advise on response strategy. The surveillance system will help in sounding alerts on pest infestations and extension services systems; This is however challenging due to the limited funding from the government. The Ministry of Livestock is also in the process of developing a specific National Livestock Policy.

2.4.3. Capacity gap in market monitoring

Market Information Systems are information systems used in gathering, analyzing and disseminating information about prices and other information relevant to farmers, animal rearers, traders, processors and others involved in handling agricultural products[12]. Zambia's Agricultural Market Information Centre (AMIC) suffers from a range of weaknesses all along the supply chain for price information. Data collection and transmission

11 Synoptic Summary: Southern and Eastern Africa Regional Technical Meeting on Preparedness and Response Actions to Emerging High Impact Trans boundary Crop and Livestock Pests and Diseases (Harare, Zimbabwe 14-16 February 2017).

12 https://en.wikipedia.org/wiki/Market_information_systems

is irregular and unreliable, data management is unstructured and lacks strategic oversight, and dissemination is entirely supply-driven. There is need to develop an information system where market data collection, analysis and reporting, dissemination and communication will be done at the district level and to recruit dedicated staff in the various districts.

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2.5. Impact of agricultural risk information and EWS on preparedness and response

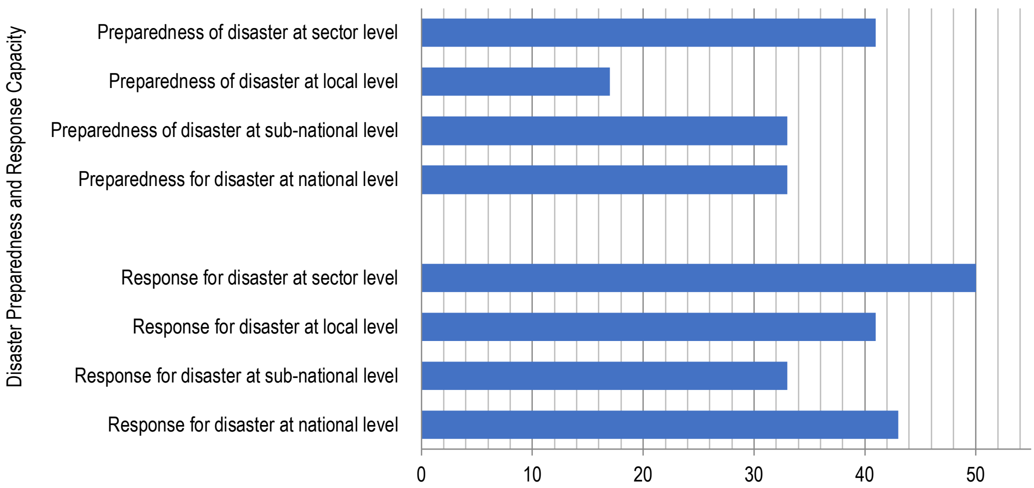
Meso-level operators were asked to rate the impact of agricultural risk information and EWS on preparedness and response in managing agricultural risks at the sector, local, sub-national and national levels on a scale ranging from 1 (low) to 3 (High). Preparedness in this context refers to disaster, while response refers to the ability to mitigate the effects of a disaster when it happens. The scores for each respondent was summed across the meso-level operators and expressed as percent of the maximum score possible (Figure 7).

Preparedness: Respondents scored preparedness at the sector level highest at 41 percent, at national and sub-national levels scored 33 percent respectively and preparedness at local level scored 17 percent.

Response: Respondents scored response at sector level at 50 percent, at national level at 43 percent, at local level 41 percent and 33 percent at sub-national level.

The findings on the level of preparedness and response to disaster have implications on the extent to which data is available and mainstreamed into the plans and strategy for prevention and mitigation of agricultural risks. It is also a reflection of the level of coordination among the meso-level operators to effectively utilize available agricultural risk information. The high percentage for agricultural sector reflects the importance of agriculture as the main source of livelihood for majority of the populations, and so much attention is paid to it. The low percentages for the national, sub-national and local levels reflects the fact that a top-down approach still exists in the agricultural risk management where information, manpower, resources and equipment are concentrated at the national level as opposed to the decentralization of these resources to local levels where they are needed for enhancing resilience the most.

Figure 7: Agricultural risk information and level of preparedness and response for managing agricultural risks (%)



Source: Field surveys

Box 4: Ministry of Agriculture - Chipata District

There are 58 agricultural camps in the district, camps are then divided into 8 agricultural zones and 8 block officers. The ratio of extension officers to farmers is recommended as 1:400 farmers but currently, 1:1000 and above farmers. Farmers principally receive agricultural information through MoA. – Extension officers, radio, electronic newsletters and other farmers.The farmers say they don't get advisories on livestock on time. Normally when there are disease and pets attacks, they report to the extension officer under MoA. For livestock diseases the farmers have to buy the drugs themselves for veterinary officers to come and administer treatment, including transport facilitation fees due to inadequate financial resources from the national government. For crops, the response is faster.

2.6. Agricultural risk information and EWS Dissemination Channels

Table 2 indicates that the respondents utilize more than one method of information dissemination channel. Extension agents and NGOs use about 13 sources of agricultural risk information. Input dealers use about 6 sources and research institutions use about 5 sources. Financial institutions/Insurance companies and farmer organizations use 2 respectively with media using only radio.

Table 2: Actual Usage of Information Dissemination Channels by Meso-level Operators

	Govt/ Extension Service Provider	Financial/ Insurance agencies	Input suppliers	Media	Research Institutions	Farmers Organizations	NGO	Total (*)
Cellphone	X						X	**2**
Electronic newsletter	X	X						**2**
Extension officer	X						X	**2**
Faith-based Organization							X	
Input dealer	X							**1**
Radio	X			X			X	**3**
newspaper	X	X					X	**3**
Newsetter/ buletin								
Other farmers	X						X	**2**
Commission agent			X				X	**2**
Cooperative	X		X				X	**3**
Field days	X		X					**2**
								(...)

(...)	Govt/ Extension Service Provider	Financial/ Insurance agencies	Input suppliers	Media	Research Institutions	Farmers Organizations	NGO	Total (*)
Field demo			X					**1**
Private company	X		X				X	**3**
IVR					X	X		**2**
Intermediaries			X					
Interpersonal communica-tion	X					X	X	**3**
Kiosk							X	**1**
Internet	X				X			**2**
Landline					X	X	X	**3**
Meeting	X				X		X	**3**
NARI							X	**1**
TV							X	**1**
Poster					X	X	X	**3**
Total b	13	2	6	1	5	4	16	

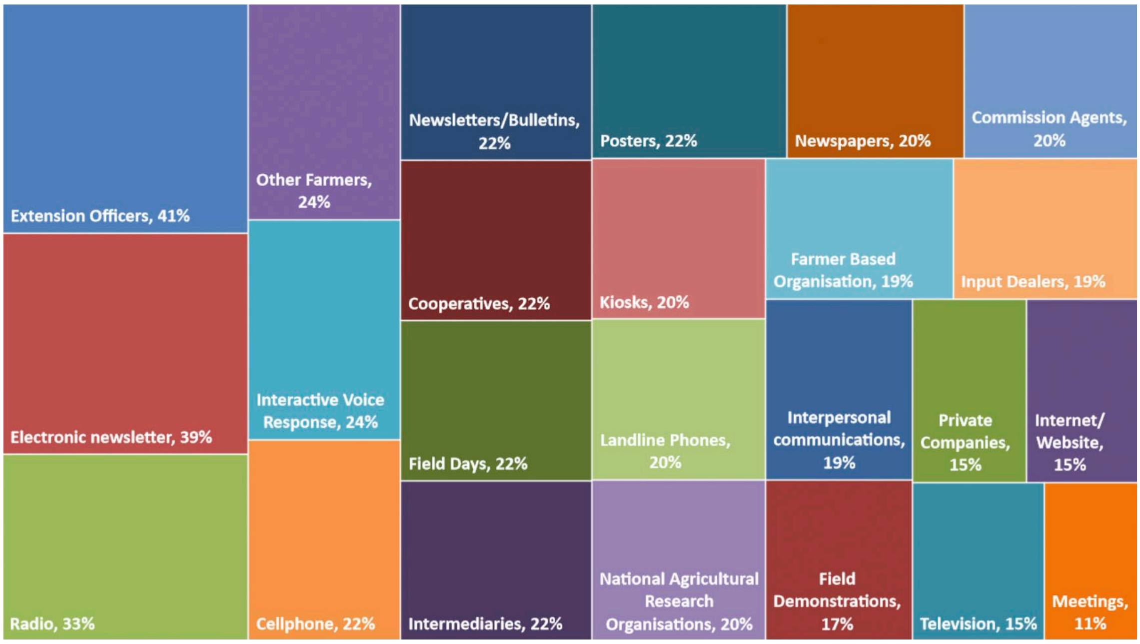
(*) Number of meso-level operators categories using a given channel; b Number of channels used by a given meso-level operator category

The number of communication channels used by each of the meso-operators covered in this survey varies very widely. The NGO used the highest number of communication channels (16 out of 24 or 67 percent) to reach end users. This is followed by government/extension (54 percent), input suppliers (25 percent), research institutes (21 percent), and farmers' organizations (17 percent).

Meso-level operators were asked to rate the preferred channels of agricultural risk information and EWS used by their organizations on a scale ranging from 1 (low preference) to 3 (high preference). The survey cited 14 main information channels used by the respondents' organizations. The scores for each respondent was summed across the meso-level operators and expressed as percent of the maximum score possible (Figure 8).

The top six channels for disseminating agricultural risk information and EWS channels are extension services with a score of 41 percent, electronic newsletter (39 percent), radio (33 percent), other farmers and interactive voice response (24 percent each), and cell phone (22 pecent).

Figure 8: Preferred information dissemination channels used by meso-level operators (%)



Source: Survey findings

2.6.1. Impact of agricultural risk and EW information

Meso-level operators were asked to rate the impact of agricultural risk and EW information on farmers production and marketing decisions on a scale ranging from 1 (low) to 3 (high). The scores for each respondent was summed across the meso-level operators and expressed in percent of the maximum score possible (Table 3).

The scores for the impact of risk information system on agricultural decision-making varies from 24 percent for influence on marketing decision to 44 percent for avoidance of crop losses to pest attack and diseases infestation. The three most prominent areas where agricultural risk information enhance farmers' decision are prevention of crop losses to pests scored at 44 percent, sowing rate (43 percent) and soil preparation (41percent). This underscores the importance of agricultural risk information for decision-making for increased agricultural productivity and improved livelihood. The impact of marketing information systems on decision-making was rated the lowest. Relevance of the marketing information system to marketing needs was scored 31 percent, regularity of use 30 percent, and influence on marketing decision, 24 percent. The low scores recorded for marketing information system suggests that the existing Zambia Integrated Agriculture Market Information System and related systems are not fully functional nor sufficiently effective for the meso-level operators' needs. It also suggests that market information systems services have not been integrated with weather or risk information in that silo operation arrangements still exist.

Table 3: Impact of agricultural risk information for agricultural production and marketing decision making (%)

Decision types	Percent	Average (percent)	
Pre-cultivation	Selection of appropriate cultivar	35	37.4
	Determination of cultivation contracts	33	
	More efficient scheduling of soil preparation	41	
	More efficient scheduling of sowing rate	35	
	More efficient scheduling of sowing time	43	
			(...)

(..) Decision types	Percent	Average (percent)	
Cultivation	Proper timing of pesticide application	37	38.5
	More efficient scheduling of fertilizer application	39	
	More efficient scheduling of irrigation	39	
	General agronomic practices for increased productivity	39	
Harvest/post-harvest	Proper timing of harvesting	37	37.3
	Avoidance of crop losses to pests and diseases	44	
	Storage conditions	31	
Marketing	Regularity of use for marketing	30	28.3
	Influence on market decisions	24	
	Relevance to marketing needs	31	

Source: Field surveys

The above analysis shows that agricultural risk information mostly influences decisions on cultivation at about 39 percent, followed closely by information needs on pre-cultivation and harvest/post-harvest at 37 percent, while marketing needs is the lowest at 28 percent.

2.7. Summary of survey findings

The survey revealed that agricultural risk information and EWS needs of meso-level operators shows that Extension service providers require the most information across the value chain ranging from pre-cultivation, cultivation, harvest, to post-harvest to enable them offer appropriate advice to farmers. Finance and market access providers require historical time series data of rainfall, yields, prices, for all crops The scores for the impact of risk information system on agricultural decision-making by meso-level operators varies from influencing marketing decision (the lowest percentage) to avoidance of crop losses to pest attack and diseases infestation (the highest percentage). The three most prominent areas where agricultural risk information enhance farmers' decision-making are prevention of crop losses to pests, sowing rate and soil preparation.

Meso-level operators indicated that traditional weather stations were more suitable, efficient and sustainable than satellite, and automatic weather stations, reflecting the lack of experience with the modern technologies of weather and climate sources. The level of preparedness and response by Meso-level operators in managing agricultural risks at the sector, local, sub-national and national levels showed that preparedness at the sector level is highest with low percentages at national, sub-national levels and local level. The respondents utilize more than one method of information dissemination channel.

The NGO used the highest number of communication channels to reach end users. This is followed by government/extension (13), input suppliers (6), research institutes (5), and farmers' organizations (4). The most preferred information dissemination channels by the meso level operators are extension services (41 percent), electronic newsletter (39 percent), radio (33 percent) other farmers and interactive voice response (24 percent each) and cell phones (22 percent).

There is need for modernization of infrastructure for data collection and dissemination, enhancing technical skills and institutional capacity, and establishing an integrated information system for Agricultural Risk Management and EWS. The next chapter elaborates the information systems for agricultural risk management and Early Warning Systems.

3. Information systems for agricultural risk management and early warning systems

3.1. An overview of Zambia's Information System for Agricultural Risk Management

An agricultural information system comprises a set of processes in which agricultural information is generated, transformed, transferred, consolidated, received and fed back in such a manner that these processes function synergistically to underpin knowledge utilization by agricultural stakeholders. The focus of risk information management system in this study is on weather, pests and diseases and price volatility. This follows then that an agricultural information system (AIS) is an integrated analytical tool to obtain the information required to increase productivity and manage risk, and to develop, share and use that information for decision making. Agriculture information is produced by various players including, government institutions, private sector, international experts, farmers' organizations, civil society organizations, and other institutions like research institutions. Information systems play a major role for agriculture, for good business practices, to improve livelihoods, increase productivity and ensure efficient value chains. An information system will enable users to have access to a wide range of information to enable proper management of risks.

Information systems have significantly evolved in recent times, in terms of the type and amount of information that is and can be gathered, but also in terms of who collects and hosts the information and how it can be accessed. Use of advanced technologies such as; satellite, geospatial data, mobile devices and internet in the production and dissemination of information is a big opportunity for agricultural risk management. With such technologies, information can be collected even from the most remote areas that had less information collected and worse access, in the past. For the insurance industry to develop new products and fill information gaps; for the financial institutions to be able to manage the risks from the agricultural sector; for farmers to improve their resilience and enhance their investments in the farm and in the household; for governments to better design their policies, they depend on the quality of the circulation of information between the various actors involved in the agricultural value chains and the ability to access the information in a timely manner.

Several agricultural information initiatives have been developed in Zambia (Table 2.1). One such initiatives is the *National Agriculture Information Services* (NAIS), a specialized information wing of the Ministry of Agriculture (MoA) developed in 1960s. NAIS is aimed at supporting the extension services of the ministry through the dissemination of agricultural information via the mass media. To cover majority of the users in the rural areas, information is disseminated through community radio facilities. The National Agricultural Information Services (NAIS) of the Ministry of Agriculture broadcasts eight agricultural information programmes on radio and Television in both English and in seven Zambia languages, that is, Bemba, Kaonde, Lozi, Lunda, Luvale, Nyanja and Tonga. In addition to dissemination of information under NAIS, the MoA also disseminates information through an agricultural cooperative newspaper which is established by a private company. The DMMU platform is also used to disseminate information on pests in case of an outbreak, since they have a wider coverage through using Short Message Service (SMS). NAIS is however not well coordinated between the district and the national office because of lack of funding. This is also a challenge to extension services.

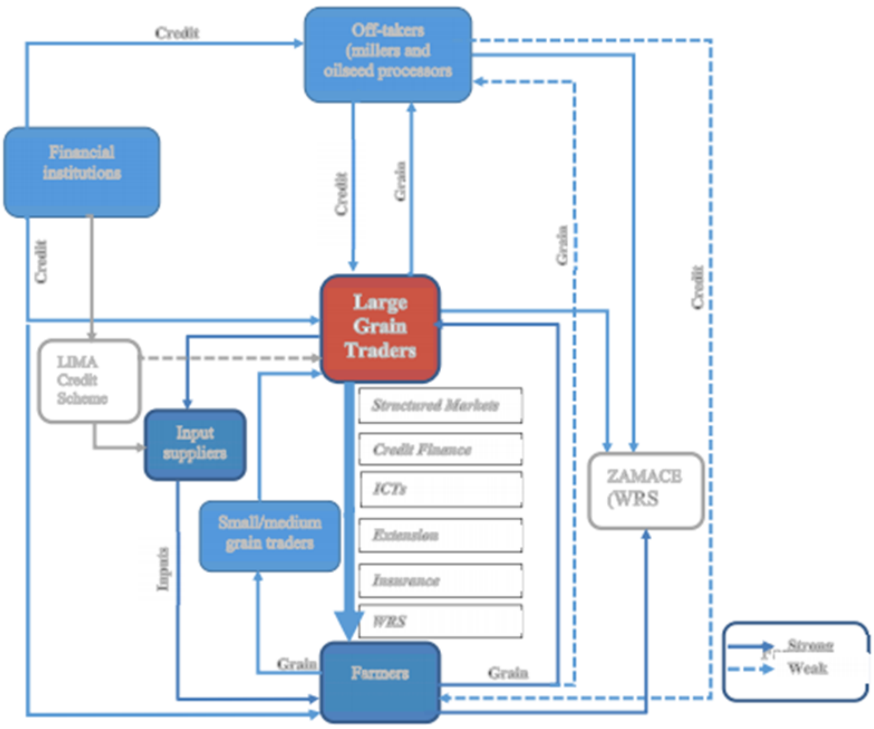
The Agriculture Market Information System (AMIS) was established by the Ministry of Agriculture to collect data on prices and volumes traded through designated markets for a range of commodities from the ten provincial headquarters. The information is collected through the District Marketing Development Officers of the Ministries of Agriculture and extension personnel in the 117 Districts and sent the 10 Provincial HQs. The price data is collected through interviewing traders in the markets. The biggest challenge is financial constraints to support the regular collection and dissemination of the information. In most cases, district officers lacked fuel and vehicles to enable their mobility, laptops for data processing, and internet facilities to enable transmitting the information, thus reporting is highly irregular. The staff involved are also not solely dedicated to this function but usually undertakes core functions such as the provision of farm extension services. With the number of challenges faced it is difficult for MoA staff to produce consistent, accurate and timely information to the public on a weekly basis.

Some of the key challenges in crop marketing in Zambia include the absence of a comprehensive agricultural marketing legal framework to guide crop marketing. The only legislation available is the Food Reserve Act of 2005 that established the Food Reserve Agency (FRA) and other stand-alone Acts for specialised commodities such as cotton and tobacco There is inadequate and untimely market information on the prices of agricultural products (particularly maize and other basic foodstuffs), and on the supply and demand of these products. The cost of doing business in Zambia is very high, partly due to poor infrastructure, high interest rates and high transport costs. Without necessary, timely and readily available market information, it is impossible for the key market participants to make informed decisions.[13]

In recent times, Zambia's grain marketing has undergone dynamic transformations spurred by massive investments in grain infrastructure led by the private sector. With this, various innovations have emerged, with potential to address the grain marketing constraints of small scale farmers and foster the inclusiveness of poor and marginalized households into the market. However, this is limited mostly to farmers within easy reach areas. The main benefit accruing to smallholder farmers is centred on the creation of structured markets through pre-financing and forward contracts, although limited to selected crops such as tobacco and cotton. The structured markets enabled farmers to have access to a ready market for their crops, credit and extension. Others, had access to storage facilities and other risk mitigation instruments such as weather index insurance which is only available under the FISP beneficiaries on small-scale agriculture . In turn these benefits were attributed to improved productivity, sales and income for smallholder farmers.

Figure 9 summarizes the interrelationships among the market actors and the main developments centered on large grain traders, meso-level operators providing various services across the value chain and farmers in Zambia. Grain flows from farmers to grain traders then to off-takers (processors). Using the future harvest as collateral, credit is channelled to farmers through input suppliers. Credit finance seldom goes straight to farmers with few exceptions. For example, the Lima credit scheme facilitated by the ZNFU and commercial banks enables farmers to access inputs and equipment directly with repayments done over a number of seasons.

Figure 9: Market Development flow chart between Grain Marketing traders, meso-level operators and farmers



Source: IAPRI, 2018

13 https://www.scribd.com/document/101814380/Parliamentary-Report-on-Crop-Marketing-in-Zambia#download&from_embed

To improve the grain market systems and control price volatility in Zambia, among other measures, the following should be done:

- Government should foster effective private sector market development through predictable and stable policies. In particular, farmers benefit from the export market as they can receive higher prices for their produce if allowed to participate freely in export markets thereby creating incentives for further investments in the production of grains. As an example, the private sector have been able to offer competitive prices to farmers during the 2016/2017 and the 2013/2014 maize marketing seasons, which exceeded the FRA price; and they purchased more volumes from farmers because they were allowed to sell both in the domestic and export markets. Given that more than 50% of the population is employed in the agriculture sector, open trade positively contributes to employment creation in agriculture (World Bank 2018). Further, open trade in grains stimulates surplus grain production, increases food availability thereby contributing to food security.
- There is need to streamline the role of the FRA in grain marketing to that of holding strategic grain reserves, which can be purchased through ZAMACE. ZAMACE requires large volumes to initialize it, thus government can help capitalize it by purchasing a portion of the Strategic Grain Reserves (SGRs) though ZAMACE. Government should consider purchasing a mixed portfolio of physical and virtual 18 stocks in managing SGR. This will limit the fiscal exposure of the government through storage costs and losses and will stimulate the role of the private sector, while continuing to provide food security.
- Furthermore, what is required to resolve the ad hoc nature of government interventions in the market is the enactment of a comprehensive Agricultural Marketing Act. The Agriculture Marketing Bill of 2010 has not yet been signed into an Act since 2010. This would see the creation of a Council consisting of government and other key stakeholders to make joint recommendations on grain marketing in the country. The enactment of the Agricultural Marketing Act will provide the legislative framework and will be an instrument for transforming agricultural marketing decision making to become rule-based rather than continuing to be at Government's discretion as it is in the current state.
- There is need to enhance awareness and implementation of the ZAMACE's warehouse Receipt System and a price recovery system among farmers countrywide.

The above indicates that Zambia has several organizational units collecting agriculture information, but unfortunately these systems do not feed into relevant integrated information systems that consolidates for dissemination to the end users. Most of the information collected are kept in formats that are not easily accessible by the intended end users. For instance, the Ministry of Agriculture through the Early Warning Unit conducts crop forecast surveys with the mandate to provide production data, while under the same Ministry, the Department of Agriculture collects information related to weather risks, disease, droughts and floods. The Ministry of Livestock on the other hand, uses the National Livestock Epidemiology Centre (NALEIC) that generates and disseminates information on early warning. The information collected in these units is not disseminated under one system, there is insufficient connection between the government units responsible for collection and dissemination of agriculture data and other institutions active in the field. This lack of coordination causes an incomplete distribution of agricultural information to meso-level operators. More integrated agricultural information systems are therefore needed in Zambia to provide more opportunities for meso-level stakeholders to access information to enable management of agricultural risks related to weather, pests and diseases and price volatility. This will requires policy commitment and funding from the government, as well as private actors along the agriculture value chain, get involved in developing the best data and information sources, and making it widely available. A review of existing information systems is provided in table 4 highlighting their strengths and weaknesses.

Table 4: Examples of Information systems for agricultural risk management and EWS in Zambia

Risk	Platform	Information provided	Users	Dissemination Channel	Challenges	Current Status of the System	Financing Sources	Responsible Institution
Weather	ZMD	10-days weather forecast for each region in the country. The agro-meteorological conditions giving an overview of the crop (maize) condition based on the crop stage and amount of rainfall received so far. A summary of the crop weather bulletin gives rainfall amounts and number of rain days for all stations that sent their reports for that period, cumulative amounts received since the season started, normal rainfall amounts up to that dekad and a departure from the norm	All stakeholders, District Agriculture Officers and Agricultural Extension Officers in the country who distribute it to farmers in their locations.	Bulletin is shared to the public through a mailing list, It is downloadable from the ZMD website and broadcasted through community radio stations.	No complete user database because the bulletin is redistributed by intermediaries, who are not mapped into the user database. Distribution of the bulletin is mainly through the internet, which many farmers in remote regions have no access to. Fewer station network. Challenge in getting all the data from the manual weather stations on time to be included in the bulletin, due to telecommunication issues.	Currently, ZMD prefers to make a shift towards providing informative weather products like the crop bulletin to end-users rather than opening all its raw data. The reason is to ensure that the data is quality controlled.	Government	ZMD
Pests and diseases	National Agriculture Information Services (NAIS)	Agricultural technologies and awareness of agricultural programmes	Extension Officers, small-scale farmers	Radio, TV and other mass-media to reach farmers		Lack of financial resources has resulted in no staff in some districts and where there are it is only one staff with no resources to adequately collect or disseminate agricultural information	Government	Ministry of Agriculture
	National Livestock Epidemiology and Information Centre	Disease events, production trends, and market intelligence, including factors influencing their occurrence.	Traders and buyers Extension officers InsurersBanks	Publication of Departmental Reports, the National Livestock Atlas, the APH Bulletin, the Livestock Market Bulletin, Epidemiology Status Papers and Monthly National Disease Status Papers.	Data capture is not real time as only one person at the national level enters the data received from 109 districts; Inadequate staffing; The available laboratories do not have capacity to serotype for foot and mouth disease vaccines. They have to send samples to South Africa or Botswana	There are plans to create a web-based EWS or surveillance system where data will be entered from the districts for easy analysis at NALEIC.	Government	Ministry of Fisheries and Livestock
Weather, Pests and diseases and markets	Disaster Management and Mitigation Unit (DMMU)	Climate data, Production data, Commodity prices and analysis related to the production, climate and commodity prices.	All stakeholders	Through bulk sms, fliers, community and national radio stations, print, electronic, directly with stakeholders, private sector ie agrodealers etc.	Outdated maps, challenges with GIS as the quality of data whether statistical or shape files/ maps; data sharing, software are quite expensive.	DMMU has developed a platform where experts analyse the data.	Government	Office of the Vice President

3.2. Donor-funded Projects that can generate useful information for agricultural risk management

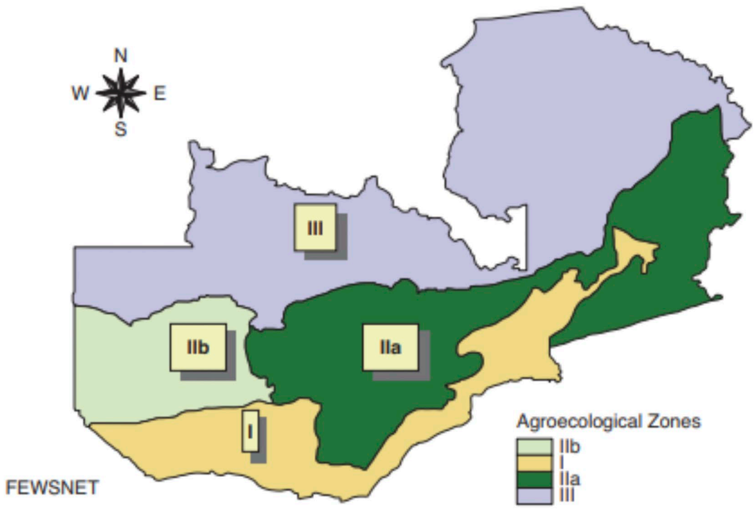
Many international institutions and organizations expressed the significance of Agricultural Risk Management (ARM) and are supporting Zambia through several initiatives. Currently, WFP is working together with DAPP and Heifer International in Southern Province (Districts of Pemba, Monze, Namwala, Gwembe and Mazabuka) through their Rural Resilience - R4 – Initiative. R4 combines four pillars of risk management: risk transfer (insurance), together with risk reduction (application of conservation agriculture); risk reserves (savings); prudent risk taking (increase of investment, including access to microcredit). The insurance product used is currently index insurance. It is a based on a combination of satellite sector (Rainfall Estimates), ground weather data, and crop and planting information. The ground weather data is collected using two automated weather stations and 28 manual rain gauges installed by the project (where they collect data on rain and soil temperature through the 2 automated stations). It is used for index insurance product development and adjustment. The data is also reported to the Zambia Meteorological Department. The management of the rain gauge is by the community committees (i.e. 2 dedicated members' male and female) using governance structures within the communities like the farmer clubs created by the project (which has 3 lead farmers and 45 follow-up farmers). Dissemination of information is also done through these structures and through participatory climate analysis who interpret the data. WFP will be extending this to the following provinces Eastern, Lusaka, Muchinga, Southern and Western.

In addition, the projects described below aim to increase resilience and agricultural productivity of smallholder farmers through better risk management.

3.2.1. Strengthening Climate Resilience of Agricultural Livelihood in Agro ecological (SCARALA) Regions I and II in Zambia.

Green Climate Fund, in collaboration with Government through the MoA, is about to start the Strengthening Climate Resilience of Agricultural Livelihood in Agro ecological (SCARALA) Regions I and II in Zambia (Figure 10).

Figure 10: Zambia's Agroecological Zones



Source: Department of meteorology

The proposed project supports the Government of Zambia to strengthen the resilience to climate change risks of vulnerable smallholder farmers in the country's Agro-Ecological Regions I and II. Anticipated number of people with increased resilience is 3.9 million. These regions are facing increasing risks as a result of climate change, primarily variability of rainfall and increased frequency of droughts, which have direct impacts on agricultural production in the region. In addition, some regions of Zambia have the highest concentration of poverty incidences and, where rain-fed agriculture is predominant. The project aims to increase the resilience of smallholder farmers in Agro-Ecological Regions I and II in Zambia in view of climate change and variability. The project will achieve this aim by taking a value chain approach, addressing risks posed across key stages of the value chain – planning, inputs, production and post-production. This includes three interrelated outputs: 1) strengthening capacity of farmers to plan for climate risk through agricultural risk information; 2) strengthening resilient agricultural production and diversification practices (for both food security and income generation); and 3) strengthening farmers' access to markets and commercialization of introduced resilient agricultural commodities.

3.2.2. Centre for Agriculture and Bioscience International (CABI) Zambia

CABI Zambia works in close partnership with key in-country organizations and the University of Zambia to achieve their core objective of helping smallholder farmers lose less of what they grow by giving them access to relevant scientific information; enabling them to sustainably address agricultural problems that limit them from securing adequate food for themselves and earning more income. As well as Plantwise, this includes trade and market access, knowledge management, invasive species management, biodiversity and ecosystem management, and nutrition sensitive and climate smart agriculture. Supporting smallholder farmers in sustainable crop production and protection, including processing and storage, will be central to the efforts.

3.2.3. Zambia Information and Communication Technologies on Disaster Early Warning System

The Zambia Information and Communication Technologies Authority (ZICTA), working in partnership with the International Telecommunication Union (ITU), DMMU and other local stakeholders embarked on a Disaster Early Warning Project for floods. The project was aimed at providing, at two pilot sites, natural Disaster Early Warning Systems for the Republic of Zambia to be used in disseminating alerts for flooding and impending disasters, for public safety and for enhancing information dissemination in designated areas. The infrastructure would also be used to provide communication links during the disaster preparedness and response phases of disaster management. The pilot was in two districts, Sioma in Western province and Kasaya in Southern province. Using ICT the project was aimed at predicting over time rainfall patterns and measure water levels, identify and put in place mitigation measures and using a public system to warn the people of the disaster.

3.2.4. Pilot Program for Climate Resilience

The Zambia Strengthening Climate Resilience (Phase II) Project in the Barotse Sub-Basin is one of the Pilot Programme for Climate Resilience (PPCR), one of the global climate funds established under the multi-donor Climate Investment Fund (CIF). The objective of the project is to strengthen Zambia's institutional framework for climate resilience and improve the adaptive capacity of vulnerable communities in the Barotse sub-basin. The total project costs administered through the World Bank are estimated at US$36 million and will last 6 years, from September 2013 to December 31, 2019. The project is expected to: Support climate resilient planning and priority adaptation activities in 8 districts and 24 wards; Assist 25,000 vulnerable households to use information, planning funding to better manage climate change and variability – priority to be given to female-headed households, very vulnerable households, and innovating champions; Provide small grants to pilot districts, wards, communities, groups and champions integrating climate resilience into local planning; Strengthen the management of 5 priority canals to allow for better operation during flood and dry seasons; Strengthen climate information to communities and planners; Pilot a local contingency fund to help prepare for potential disasters; and Establish a National Climate Change and Development Council or equivalent institution, effectively coordinating climate change funding, programmes and projects, and increase the budget for climate resilient programmes in vulnerable sectors (agriculture; natural resources, transport, health, water and energy, and disaster risk management).

3.2.5. Strengthening climate information and early warning systems in Eastern and Southern Africa for climate resilient development and adaptation to climate change – Zambia

The project objective is to strengthen the climate monitoring capabilities, early warning systems and available information for responding to climate shocks and planning adaptation to climate change in Zambia. The project is being implemented by Ministry of Transport, Works, Supply and Communication (ZMD). The project aims to achieve an enhanced capacity of Zambia Meteorological Department to monitor and forecast extreme weather and climate change and efficient and effective use of hydrometeorological and environmental information for making early warnings and long-term development plans.

3.2.6. Leveraging the World Bank's Agriculture Intelligence Observatory for Agricultural Resilience

The ZMD weather forecasts indicate that the 2018/19 weather patterns will be largely influenced by the El Nino Southern Oscillation (ENSO), implying that the country is likely to face drought conditions in agroecological zones I and II of Central, Eastern, Lusaka, Southern, Muchinga and West Provinces. There is also a possibility of localized flooding in agroecological zone III comprising the west bank of North-Western, Lusaka, Central, Eastern, Luapula, Southern Muchinga and Northern Provinces (table 5).

Table 5: Potential impacts of 2018/19 El Nino induced hazards in Zambia as documented in the National Contingency Plan

No of districts affected by floods	42
No of districts affected by droughts/dry spells	52
No of hotspot districts	64
No of provinces	9

Following the forecasts, the DMMU working with other stakeholders developed an all-inclusive, multi-hazard National Contingency Plan (NCP) for 2018/19[14]. The NCP allows for early response to anticipated hazards to minimize the impact on vulnerable households and support and protect lives and livelihoods in hotspot areas.

To enhance readiness and response to weather-related emergencies, the GRZ is leveraging the geospatial capabilities of the World Bank's Agriculture Intelligence Observatory (Ag Observatory) to target interventions in vulnerable communities. The Ag Observatory supplies real-time, high resolution agricultural weather information generated from a combination of existing meteorological ground stations, satellite platforms, and the application of big data, artificial intelligence, and machine learning. The Ag Observatory combines data sources from free access public sector data with private sector information that is, available through subscription from aWhere Incorporated (figure 11). Integrating data from both sources allows resource managers to monitor actual weather patterns in near real time, and to make projections of weather impacts on food security, vulnerable populations, and identify El Nino and extreme weather hotspots that can cause income losses, food security and other related emergencies. The Ag Observatory is aligned with the NCP to better identify vulnerable areas and communities and target interventions across the country.

14 https://www.zambianobserver.com/disaster-management-unit-says-there-will-be-serious-drought-cholera-army-worms-locusts-and-other-biblical-plagues/

Figure 11: Data sources for the Ag Observatory: Tracking food and feed systems

Public Sector – Open Access (free)	**Private Sector – Proprietary (client subscription/contract)**		
• Global Crop Monitoring (GEOGLAM) • UN-FAO Global Information & Early Warning System (GIEWS) • USAID FEWS NET • USDA GADAS • NASA Earth Observatory (EOS)	**Complete Global Ag-Met Information at 9 km × 9 km** > 1.5 million big data generated virtual weather stations > 7 billion data ppoints updated every six hours		
	Daily Observed (> 10 years baseline) • Precipitation • Min/Max Temperature • Min/Max relative Humidity • Max/Mean wind Speed • Solar radiation	**Hourly Forecast** • 7 days of hourly forecast • Updated 4× daily	**Agricultural Intelligence** • potential (PET) evapotranspiration & Crop stress indices • Plan growth, crop calendars • Soil moisture, net water • Pest & disease indices • Crop Suitability • Yield & Production

Source: Presentation at Earth Observation for Sustainable Agricultural Development Awareness Event, Lusaka September 27, 2018

The projects and initiatives described above indicate that several efforts are being made to collect agricultural data. However, there is need for collaboration among government agencies and development partners to avoid duplication of efforts in the task of making agricultural information systems more functional in the country. This will help channel limited resources into developing an integrated agricultural information system with relevant applications to broad user groups. This will foster the exchange of knowledge and experience to assist the public and the private sector in developing a more structured knowledge-based approach towards agricultural risk information and early warning systems in the country.

In summary, the following lessons can be learned towards the design of a national agricultural risk management system in Zambia:

- Coordination of data collection and information flow across key stakeholders will markedly improve the monitoring of the performance of agriculture risk and EWS information systems.
- Integrated information system can serve as a platform for production of knowledge and information sharing on agricultural risks across broad user groups
- Leveraging the Ag Observatory is an opportunity for capacity building in satellite-based systems, accessing publicly available satellite data, and collaborating with private sector for delivery of functional agricultural risk management system.

3.3. Examples of Agricultural Risk Information and Early Warning in other Countries

IFAD Country Strategic Opportunities Programme (COSOP) (2011-2015) was built on the lessons from the previous programmes, and maintains the goal of increasing the incomes, improving the food security, and reducing the vulnerability of rural people living below the poverty line. A Mid-term Review in 2013 established that the focus of the COSOP was still relevant within the national policy and strategic context. The portfolio interventions of the current COSOP are aligned with: (i) the agricultural development strategies of the government; (ii) IFAD's strategic framework and policies; and (iii) interventions of other development partners. IFAD through the Platform for Agricultural Risk Management plays the role of facilitator in bundling the know-how for the development of methodologies for risk analysis and the adoption of risk management strategies, integrating risk management instruments and approaches in public policies, private sector practices and agricultural investment programs.

Some examples from other countries on integrated information systems that such support could leverage are highlighted in Table 6.

Table 6: Some examples of integrated agricultural information systems from around the world

Risk	Platform	Information provided	Users	Dissemination Channel	Challenges	Current Status of the System	Financing Sources	Responsible Institution
Weather	ZMD	10-days weather forecast for each region in the country. The agro-meteorological conditions giving an overview of the crop (maize) condition based on the crop stage and amount of rainfall received so far. A summary of the crop weather bulletin gives rainfall amounts and number of rain days for all stations that sent their reports for that period, cumulative amounts received since the season started, normal rainfall amounts up to that dekad and a departure from the norm	All stakeholders, District Agriculture Officers and Agricultural Extension Officers in the country who distribute it to farmers in their locations.	Bulletin is shared to the public through a mailing list, It is downloadable from the ZMD website and broadcasted through community radio stations.	No complete user database because the bulletin is redistributed by intermediaries, who are not mapped into the user database. Distribution of the bulletin is mainly through the internet, which many farmers in remote regions have no access to. Fewer station network. Challenge in getting all the data from the manual weather stations on time to be included in the bulletin, due to telecommunication issues.	Currently, ZMD prefers to make a shift towards providing informative weather products like the crop bulletin to end-users rather than opening all its raw data. The reason is to ensure that the data is quality controlled.	Government	ZMD
Pests and diseases	National Agriculture Information Services (NAIS)	Agricultural technologies and awareness of agricultural programmes	Extension Officers, small-scale farmers	Radio, TV and other mass-media to reach farmers		Lack of financial resources has resulted in no staff in some districts and where there are it is only one staff with no resources to adequately collect or disseminate agricultural information	Government	Ministry of Agriculture
	National Livestock Epidemiology and Information Centre	Disease events, production trends, and market intelligence, including factors influencing their occurrence.	Traders and buyers Extension officers InsurersBanks	Publication of Departmental Reports, the National Livestock Atlas, the APH Bulletin, the Livestock Market Bulletin, Epidemiology Status Papers and Monthly National Disease Status Papers.	Data capture is not real time as only one person at the national level enters the data received from 109 districts; Inadequate staffing; The available laboratories do not have capacity to serotype for foot and mouth disease vaccines. They have to send samples to South Africa or Botswana	There are plans to create a web-based EWS or surveillance system where data will be entered from the districts for easy analysis at NALEIC.	Government	Ministry of Fisheries and Livestock
Weather, Pests and diseases and markets	Disaster Management and Mitigation Unit (DMMU)	Climate data, Production data, Commodity prices and analysis related to the production, climate and commodity prices.	All stakeholders	Through bulk sms, fliers, community and national radio stations, print, electronic, directly with stakeholders, private sector ie agrodealers etc.	Outdated maps, challenges with GIS as the quality of data whether statistical or shape files/ maps; data sharing, software are quite expensive.	DMMU has developed a platform where experts analyse the data.	Government	Office of the Vice President

4. Investment plan

4.1. Improving access to agricultural risk information

This section points to the set of actions required to improve access to agricultural risk information for meso-level operators to enable a positive change in the management of agricultural risks. This plan has been developed in response to the issues identified by various stakeholders interviewed and consulted, namely (i) improvement and modernization of the physical infrastructure for data collection and improving the use of ICT infrastructure for data collection and dissemination; (ii) enhancing technical skills for data interpretation and dissemination; (iii) developing an integrated information system comprising weather, pest and market information for agricultural risk management and EWS to enable end users access data and information under a single platform.

4.1.1. Modernization of infrastructure for data collection and dissemination needs

Improving infrastructure for data collection

Modernizing the hydromet infrastructure to provide weather data and information required by the end users is key for agriculture risk management. The stakeholder consulted revealed that there are major infrastructure and technical skills gaps in Zambia's EWS. This was largely attributed to the insufficient modern infrastructure like Automatic Weather Stations, software to effectively collect, analyze and disseminate the information within the Zambia Meteorological Department. Accurate and frequent observation of weather data is key to inform management of agricultural risks related to production and market risks. Thus, there is need for upgrading data collection tools from the traditionally used manual and paper-based tools to the use of tablets and cloud based servers. As discussed in this report the ZMD is the key institution collecting weather data in the country and feeding on to other relevant ministries, thus it is key to address the infrastructure challenges at ZMD. What is required is to install and upgrade observing stations across the country. Equipment to be procured will include automatic weather stations, agro-meteorological stations, automatic rain gauges, automated and manual hydrological and hydrogeological stations. Computers and software for processing satellite-based data and generating information in near real-time will also be included.

Box 5: Assessing the costs of installing new Automatic Weather Stations across the country

ZMD is mandated to provide meteorological products and services to all sectors of the economy. The effective performance of economic sectors is dependent on accurate weather information, particularly for sectors such as agriculture, given the dependence of the sector on rainfall. ZMD operates 77 weather stations, of which 38 are automatic and 39 are manual, whilst 28 are currently being installed. In terms of data management, information products (1-7 days' weather forecasts and 10-day crop weather forecasts) are produced at ZMD National headquarters. ZMD provides various weather bulletins, electronically and in other media formats they also issue a seasonal rainfall forecast in September/October once per year. However, ZMD has limited capacity to conduct data analysis, and modelling, and to interpret the data for the end users.

Investing in agro-weather tools will improve access to agricultural risk information. This will assist meso-level stakeholders in managing weather-related shocks, and sustaining agricultural production under the changing climatic conditions. ZMD requires an agro-meteorology department that can use crop models and produce the yields indices for various crops in different regions, plus other services like sowing windows, sowing calendars, etc.

Information is collected manually from the field. This is expensive since officers will require transportation to visit remote places to collect information. If the government is to equip each of the 114 districts with a vehicle, expenditure on vehicles alone will be $4.5 million assuming the cost of a 4-wheel vehicle is $40,000. These prohibitive costs limited extension services to farmers as most district officers do not have the means of transport to access remote locations. Therefore, this study has recommended introducing the use of modern technologies to collect information in remote areas in a cost-effective manner. . This can be achieved through use of satellite data and also empowering farmers with mobile phones with applications for recording data on crop, pests, production and weather, which is then transmitted to the extension staff at the camp level. In 2017, the government commissioned a project to construct 1,009 communication towers across the country in rural areas at a cost of US$280 million by Zambia telecommunications company network (ZAMTEL), so far, a total of 472 have been completed by end 2018. This is expected to increase mobile coverage and access to telecommunication services in remote areas. ..

Improving information dissemination

To enhance the dissemination of agricultural information and early warning information, there is need to invest in strengthening the communication capabilities among relevant agencies, that is, MoA, ZMD and the DMMU at all levels (national, provincial and district). The strengthening of information dissemination at the district and community level is of primary importance since most farmers operate at this level. Improved information accessibility has positive effect on the agricultural sector and individual producers, however, gathering and distribution of information can be challenging and expensive. The use of information and communication technologies (ICT) offers capability for improved quality and quantity of information that is available to all stakeholders in the agriculture value chain and for reduction of information distribution costs to all interested users (Milovanović, 2014). ICT mobile communication technologies can help disseminate information crucial for risk management to farmers, even when they are in remote places. Mobile phones are among the most widely accessible technology by majority of the people even in remote areas, thus improving connectivity will enable farmers and other stakeholders obtain market information (prices), weather forecast, agronomic advisories and other services.

Box 6: Benefits of the use of ICTs in Agricultural information service delivery

Zambia is taking positive steps to incorporate new ICTs in the agricultural sector particularly in production and marketing strategies. With the growing demand for technical information generation and dissemination by famers, and rapid changes in technology, the ministry has in recent years been designing programs meant to use ICTs in service delivery. Use of ICT has been piloted in rural Zambia to help farmers increase their production and productivity. For instance, through the National Agricultural Information Services (NAIS) with financial support from the International Institute for Communication and Development (IICD), the Ministry of Agriculture and MoFL then set up two projects: i) Strengthening the Agricultural Information Flow and Dissemination System for the National Agricultural Information Services (SAIFADIS) by setting up agricultural information centers in Kasama on a pilot basis to enable farmers have access to agricultural technical information closer to their doors steps; and ii) An Information Flow Network for the Zambia Agriculture Research Institute (INFORNET) which was Internet based platform to enable farmers send questions on agriculture and receive answers using their mobile phones.

The results were: Improved information sharing through an operational and easily usable local area network at HQ; Improved NAIS efficiency in gathering of information products from Zambia Agricultural Research Institute (ZARI), Ministry of Agriculture, subject matter specialists and other stakeholders; Strengthened linkages between NAIS, ZARI and extension; NAIS staff trained in ICT use; and Project incorporated in GRZ budget

The Ministry has decided to up-scale it to cater for all the farmers country-wide. Enhanced public private partnership initiatives in promotion of ICTs in all agricultural sub-sectors will address issues of improving knowledge flows and policy environment in the sector. This will increase the economic viability of farm enterprises by increasing profitable market access and production efficiency, increasing the political empowerment and social inclusion of rural communities. (*InfoBridge Foundation, 2017*)

In addition, to enhance access to information, it is crucial to upgrade selected community radio stations to enhance their coverage. The field survey reviewed that radio is among the top information channels used to disseminate information. Community radio stations are an effective and low-cost way to provide information to both rural and urban communities. However, many community radio stations can only transmit across few kilometers, necessitating enhancement of coverage.

4.1.2. Enhancing technical skills and Institutional capacity

Crop pests and diseases information collection and dissemination in the Ministry of Agriculture is largely dependent on the extension officers in the field. However, the number of staff in the field is very low compared to the number of farmers they must reach and the distances they must cover. The ideal ratio per extension officer is 1:400 farmers (MoA). This however is not the case; the current extension worker to farmer ratio is 1:1200 for crops production, and 1: 3000 for livestock production[15]. These ratios are far below the recommended standards. As such, staff are not able to reach all the farmers, and the information collection is also inadequate. Shortage of extension staff is significant in most provinces except Lusaka that currently has about 1 percent vacancy rate (Table 7) Eastern province with 239 camps only 194 camps manned, leaving a gap of 45 camps corresponding to staffing gap of 19%.

Table 7: Extension Staffing Levels in the Ministry of Agriculture

Province	Block	Camp	Manned	Vacant	Vacant rate (%)
Lusaka	19	103	102	1	1
Eastern	36	239	194	45	19

Source: MoA

Adequate number of extension officers will allow extension services to be more responsive to the needs of local farmers, and especially small-scale farmers. In addition, it will also increase coverage for agricultural data collection in the field. Apart from having the numbers, it is also key that these staff are well-trained and well-equipped to provide appropriate technical advice and disseminate information. In addition, the use of ICT for agricultural extension services is also vital, as this will help scale up extension and advisory services and enable officers collect and disseminate information in an effective and timely manner. Therefore, significant capacity development is necessary to match staff's skill sets with that required to successfully and sustainably operate a modernized system. Both technical and managerial training is needed. Furthermore, capacity development of national, provincial and district offices is needed to engage end users and to assist various end users at all levels in utilizing weather and climate information products in decision making.

4.1.3. Creating Sustainable Public-Private partnership

Public Private Partnership (PPP) is a formalized partnership between public institutions and private partners designed to address sustainable agricultural development objectives, where the public benefits anticipated from the partnership are clearly defined, investment contributions and risks are shared, and active roles exist for all partners at various stages throughout the PPP project lifecycle.[16] It helps to break the downward trend of under-investment, poor infrastructure, deficient services, low visibility, and insufficient funding that are a threat to government services. Public-private partnerships have the potential to provide more efficient services through synergies and complementarities from both public and private strengths.[17]

15 http://cbz.org.zm/public/downloads/National-Agricultural-Extension-Services-Plan.pdf
16 http://www.fao.org/3/a-i5699e.pdf
17 http://documents.worldbank.org/curated/en/706021467995075539/pdf/103186-REVISED-PUBLIC-AG-GP-TAP-CIS-Providers-in-Kenya-WEB-02292016.pdf

Smallholder Irrigation Project (SIP) - Zambia

The Small-scale Irrigation Project (SIP) funded by Africa Development Bank and Africa Water Facilities is a Public-Private Partnership (PPP) management model initiated in 2012 where smallholder farmers group together, bring their land together which is then clustered into one commercial farm. The government (public) then mobilizes resources for construction of bulk-water supply and infield irrigation equipment. The farmers are the helped to create a multi-purpose vehicle, a limited liability company (private), to help them run the farm sustainably as a business. The farmer owned company recruits professional management staff in charge of management of the scheme and dealing with all aspects of agribusiness. The farmers benefit from payment for their labour, while at the same time receive dividends from their company.

Ownership of infrastructure: Since the construction of infrastructure is financed using public resources, the bulk water supply and irrigation and drainage infrastructure remains the property of the Republic of Zambia, but is leased out to farmers for either a specific concession period, or an indefinitely through a suitable **Public Private Partnership (PPP)** agreement in accordance with provisions in the Public Private Partnership Law.

Company management unit: The professional company management unit lead by the general manager is expected to manage the scheme efficiently as a business. Apart from coordinating the day-to-day activities related to production and marketing of crops, the management unit is tasked prepare business plans, cropping plans, as well as carry out market surveys and secure market contracts.

Management board: Management Boards are appointed to oversee the operations of farmer owned companies and give policy direction. The boards consist of a diverse group of influential members including two elected representatives of farmers, professionals, government officials, public health and healthcare providers, business executives, and community leaders. Each member is expected to use his/her access and influence to support the growth and development of the irrigation schemes.

Role of farmers in the management and operations of the scheme: Farmers are not involved in the day today running of the company. The operations of the company is the responsibility of the general manager. This is intended to remove any conflicts that may arise among the community. Instead farmers are recruited to provide seasonal labour which is paid for. All farmers are required to support the programs designed by the company management unit. The farmers shall therefore receive income from their labour and also receive dividends from company profits at the end of the year or proceeds after sale of crops.

Role of Government in Scheme Management: The Government does not have direct involvement in the day-to-day running of the schemes after commissioning and hand-over to the farmers. Instead, the operation and maintenance function remain the responsibility of the farmers themselves with assistance from an independent professional entity and the management board.

The Government through various ministries continues to provide vital services to farmers in the scheme in areas of agricultural extension, health, education, environment, recreation, gender, and water resources management.

In conclusion, the PPP SIP Model of smallholder irrigation scheme management has been found successful and promising at Manyonyo Irrigation Scheme in Chikankata District, and also at Nzenga and Sinazongwe irrigation schemes in Sinazongwe districts. New irrigation projects such as Upscaling Smallholder Project (USIP), and APMEP have evolved from this project while bringing in new elements to improve its sustainability.

However, the success of this model depends on the cooperation among the farmers and the capabilities of company management unit in operating and managing the schemes as a business.

Kenya Livestock Insurance Program

Kenya Livestock Insurance Program (KLIP) is a public private partnership in agricultural risk management implemented by the Government of Kenya trough the State Department of Livestock (SDL) with the help of local insurance companies and is supported by the World Bank, the International Livestock Research Institute and Swiss Re.

KLIP is a forage index insurance, designed to assist vulnerable pastoralists in the Arid and Semi-Arid Lands (ASALs) of Kenya to build resilience to severe droughts by making timely insurance payouts to the pastoralists for them to purchase fodder, water, veterinary drugs, etc., to keep their animals alive until the drought has passed and forage conditions return to normal.

The programme applies satellite-based index insurance to protect pastoralists in remote areas. Satellites assess the state of the grazing conditions in a certain region by measuring the colour of the ground. Green is good while yellow is very dry. Once a certain threshold is reached the insured automatically receive a lump sum payment, allowing them to provide their livestock - which includes cows, goats and camels – with feed and water, to survive. The fact that KLIP is designed to keep livestock from dying, allows the pastoralists to hold on to their way of life and means of survival.

KLIP contains two key components:

1. **Component one**: Large scale social protection cover under which the Government of Kenya through the State Department of Livestock funds full premiums for drought insurance protection for small-scale vulnerable pastoralists (beneficiaries) for a fixed number of five (5) Tropical Livestock Units (TLUs). This component was launched in the Short Rains season of 2016 with 5,012 vulnerable pastoralists located in Turkana and Wajir. The program has since been up scaled to Mandera, Marsabit, Isiolo, Tana River, Garissa and Samburu Counties covering a total of 18,000 pastoralists in the 8 counties each with 5 TLUs. The government will continue providing component one to selected vulnerable herders in the foreseeable future.
2. **Component two**: Voluntary sales designed to give opportunity to any herders interested in insuring their livestock against drought in counties KLIP is being offered. This component is designed to develop a sustainable commercial insurance market for livestock insurance in the ASALs and builds on the experience of the Index-based livestock insurance (IBLI) program. To make index insurance more accessible and affordable to small-scale pastoralists, SDL will provide partial premium subsidy support for this voluntary sales component to a limited number of TLUs.

SDL provides subsidy for voluntary component of upto 50% on commercial premium charged by underwriters and approved by SDL. The subsidy is available to all the pastoralists in the counties where KLIP is being offered. The subsidy is capped at 10 TLUs per herder; those who want to buy over and above what is subsidized can still do so but will pay market premium rates. The subsidy administration is undertaken by SDL and Government of Kenya Financial regulations is applied. Voluntary cover is same in design and cost as the fully subsidized component one in the 2017/2018 cover period. The interested parties must agree to follow the KLIP Component one terms and conditions and pre-agreed triggers (threshold and exit) to maintain consistency between the two components over triggered events, payouts and outcomes. The Insurer(s) is required to submit sales details to KLIP Coordinator on a weekly basis during the sales window (August to September just before the short rainy seasons of October to December and January to February just before the long rains of March to June) of the number and value of the voluntary sales they have achieved in each Unit Area of Insurance (UAI) and County.

Filing for subsidy reimbursement

1. SDL will provide 50% premium top up collected from herders by underwriters and their agents up to ten (10) TLUs.
2. The SDL will process the 50% subsidy up on receiving documentary evidence from underwriters on number of clients who have purchased livestock insurance cover and amount no exceeding premium equivalent for five TLUs per herder. The SDL will adopt buy-one-get-one free principle; meaning herders must purchase insurance cover for whole TLU unit.

3. The insurer will comply with the procedures prescribed by GOK for reclaiming the 50% KLIP voluntary premium subsidies. SDL will need proof that a KLIP Voluntary Policy has been sold to each insured pastoralist as well as evidence of the number of insured TLU's per herder, their sum insured and the applicable premium rate for that UAI and the value of the full premium and the 50% of premium paid by the pastoralist
4. SDL's Financial Department will require that the Insurer to submit a proof of payment for the policy for every insured confirming their Policy Number and the date when the contract was signed and which shows confirmation of the amount of premium paid by the Insured.
5. SDL will take period not exceeding 60 days to settle the 50% premium subsidy amount to the Insurer after submitting its final Voluntary Sales Premium Bordereau and any other required information.

Business structure in subsequent insurance cycle

In future seasons, SDL will be considering allocating the premium underwritten under component one in proportion to the volume of sales of each underwriter or their agents under component two or any method that will encourage growth of voluntary sales.

4.1.4. Enhancing the Zambia Market Information System.

To improve the performance and risk management of the agricultural market, the market information should be properly analyzed and immediately made available to relevant policymakers, traders and farmers. Special emphasis should be given to the generation and availability of current market information to improve the production, marketing, and risk management decision making of farmers and traders based on the prevailing actual market condition all over the country. In order for this to be achieved, the following issues require due attention of market information: i) Relevance of the market information to users; ii) enhance the skills and financial capacity of ZIAMIS to take the responsibility in generating, processing and disseminating market information through an integrated information system, This will eliminate redundancy of efforts and reduce both financial and human resource requirement; and iii) Regular training for staff responsible for market information collection, processing and dissemination.

4.1.5. Building Integrated Information Systems for Agricultural Risk Management

In addition to infrastructure improvement is the need to address the challenge of data management, and dissemination. The study establishes that there is a need to link the data collected in the field to the specific information systems for weather, pests, and market information and includes data processing, quality control, data archiving and dissemination to improve the access for meso-level operators. For example, market price services are not provided in a vacuum. Farmers also want information related to agricultural processes, pests, weather, sources of inputs and more. It may be most cost effective (and hence more likely to be sustainable), if a platform combines market price services with other information services. [18]The information platforms should include both public and private actors. Given that the government has budget constraints for information management, the proposed information systems will be designed to include private sector as a main actor for investments and maintenance, whereas the government maintains its role of regulation and providing an enabling environment. The private sector can produce and deliver value added products and services and promote their widest and most productive commercial application to enhance the efficiency of the agriculture sector. .

Investing in improving the mode for transmitting information is key for Agricultural Risk Management in Zambia. Some of the constraints faced in Zambia include poor connectivity to telecommunication and internet, low bandwidth, and low access to electricity which hinder access to information particularly in the rural areas. Therefore, aside from the traditional coordinating activities led by the ministry of agriculture as discussed in the chapter

18 https://d3n8a8pro7vhmx.cloudfront.net/eatradehub/pages/1134/attachments/original/1438870910/AN_ASSESSMENT_OF_MARKET_INFORMATION_SYSTEMS_IN_EAST_AFRICA_(1).pdf?1438870910

above, many other institutions in the country contribute to collection and dissemination of agricultural information. These include farmers, farmer organizations, national, provincial and district agriculture extension staff, research institutions, meteorological department, disaster management and mitigation unit, and many other public institutions. These actors most of the time generate the information in isolation, as such the need for an integrated information system.

The study established that, accessing information from the government ministries particularly the MoA proved a challenge for most meso-level as it requires several formalities to request for archived data and when it comes to real time information, it is even a much bigger challenge since the Ministry has no real time platform that provides key agricultural information. Currently, the data is kept in a file-based system on the computers of various officers within the Ministry. While some data are available from relevant ministries, most of the data available is incomplete, out of date, and in most cases missing for some locations.

Building on several information platforms that have been developed in Zambia (see Chapter 2), creating an integrated web-based information system for agricultural risk management will serve as a platform for production of knowledge and information on agricultural risk. This is where data, information and knowledge on Agricultural Risk Management will be made available to all stakeholders, with an emphasis on the meso-level stakeholders as end-users. For instance, access to information about crop prices in different markets increases the bargaining power of farmers and according to a provider of a mobile crop information services, it is estimated that with this information, farmers can boost incomes by 10-30%[19].

The operationalization of this platform (Decision Support System) will be such that information is collected from all public and private institutions and making it available to the public on one website. The main aim will be to provide information useful for the management of agricultural risks. Having an integrated platform will also help address most of the challenges experienced within some existing systems. In addition, it will also ensure a two-way communication between users and providers of information, so that warning information can be provided to meet the day to day needs of the population and institutions can appropriately incorporate local knowledge within overall systems.

4.2. Investment Costs

The purpose of the investment plan is to facilitate the establishment of an integrated information system for agricultural risk and early warning information. This Investment Plan is proposed for a period of 5 years identifying the costs needed to operationalize the set of actions required to improve access to agricultural risk information for meso-level operators to enable a positive change in the management of agricultural risks as identified above.

The investment plan supports the modernization of an integrated information system for agricultural risk and EW information that looks at weather, pests and diseases and market risks. The system will require: (i) use of modern tools and systems for data sourcing and analysis of pests and diseases, prices, including automatic meteorological measurements and satellite data products on a near real-time basis (ii) formulation of highly practical advice that farmers can apply directly to their practices; and (iii) dissemination of advisories to farmers using modern information and communication technologies and existing agricultural knowledge networks. These recommendations are in line with the survey findings that established the need for improved access to agricultural information and EWS including farming weather, potential pest attack and diseases infestation, farming best practices, and market information for enhanced resilience. The plan further builds on the existing initiatives which have been discussed in Chapter 2. It will leverage existing expertise and commitments from both the public and private sector. The cost elements for the investment plan is summarized in table 8.

19 https://www.weforum.org/agenda/2015/06/8-ways-africa-can-raise-farm-productivity-and-boost-growth/

Table 8: Costs Elements for the Investment Plan

Activity		Cost distribution (USD)					Total investment cost(USD)	Lead agency[b]	Proposed source of funding
		Year 1	Year 2	Year 3	Year 4	Year 5			
Component 1: Modernization infrastructure for data collection and dissemination									
Improving infrastructure for weather data collection at ZMD[c]	Procurement of Automatic weather station, one server and a license for one station[d]	40,000	40,000	40,000	40,000	40,000	200,000	ZMD	National budget; donor funding
	Procurement of Automatic Rainfall station, server and license	80,500	80,500	80,500	80,500	80,500	402,500	ZMD	National budget; donor funding
	Procurement of downscaling hardware/ tool	16,000	-	-	-	-	16,000	ZMD	National budget; donor funding
	Procurement of downscaling software	7,000	-	-	-	-	7,000	ZMD	National budget; donor funding
	Upgrading of 77[e] existing agro- meteorological stations and provision of remote sensing satellite systems to improve data collection and geographic coverage	-	117,000	45,000	45,000	30,000	237,000	ZMD	National budget; donor funding
	Upgrading ICT infrastructure at national and provincial offices	75,000	75,000	75,000	75,000	75,000	375,000	ZMD, MoA, ZICTA	National budget; donor funding
Improve internet connectivity, through installation of communication towers across the country in rural areas [f]	Provision of Internet Services	38,000	38,000	38,000	38,000	38,000	190,000	Ministry of Transport and Communication; MoA, ZMD; MoFL; and Telecommunication companies	National budget
Improve collection of agricultural data at all levels[g]	Procure tablets for extension officers[h]	70,000	280,000	-	-	-	350,000	MoA; MoFL	National budget; donor funding
	Provision of internet services for field staff	40,000	40,000	40,000	40,000	40,000	200,000	MoA	National budget;
	Develop GIS and remote sensing facility at provincial HQs in all 10 provinces (to promote the use of remote sensing/satellite for data collection to cover remote areas)	170,000	340,000	340,000	-	-	850,000	MoA	National budget; donor funding
Total budget		**536,500**	**1,010,500**	**658,500**	**318,500**	**303,500**	**2,827,500**		
									(...)

b Detail description of the roles given in annex table 1.2 below
c With the assumption that this is done across the country in 10 Provinces. A unit cost for establishing an automated weather station is at USD 19,815 and that of an automated rainfall station is USD 40,239
d Procurement of 10 stations. Assumption made is that two stations are installed per year at cost of USD 20,000 each, Cost also includes maintenance
e of which 38 are automatic and 39 are manual,
f Government is in the process of constructing 1,009 communication towers across the country at a cost of US$280 million to increase mobile coverage and access to telecommunication services in remote areas.
g Additional resources required in terms of tablets for extension officers; and More extension officers and transport facilitation required
h On average there are 24 field officers in each district, thus a total of 2,736 field offices in 114 districts. cost of a tablet estimated at $110.

(...) Activity		Cost distribution (USD)					Total investment cost(USD)	Lead agency[a]	Proposed source of funding
		Year 1	Year 2	Year 3	Year 4	Year 5			
Component 2: Enhancing technical skills and institutional capacity									
Institutional capacity building for key government agencies and departments such as ZMD; DMMU; Department of Agriculture and the Early Warning Unit within the MoA, the NALEIC within Ministry of Fisheries and Livestock (MoFL), among others	Facilitate training of staff in data collection and analysis	168,000	168,000	168,000	168,000	168,000	840,000	MoA, ZMD, DMMU, MoFL	National budget; donor funding
	Institutional capacity (training, AWSs/radars O&M, and so on)	10,000	10,000	10,000	10,000	10,000	50,000	ZMD	National budget; donor funding
	Technical capacity (human resources capacity building)	94,000	234,000	234,000	234,000	140,000	936,000	ZMD	National budget; donor funding
	Strengthen extension systems in MoA, MoFL	140,000	294,000	213,000	198,000	194,000	1,039,000	Government	National budget; Second National Agriculture Investment Plan budget
	Strengthen risk management and disaster mitigation capability	298,000	306,000	306,000	298,000	256,000	1,464,000	Government	National budget
Providing appropriate ICT infrastructure for data collection, processing and storage	Provision of IT equipment and operations and maintenance budgets.	122,000	84,000	80,000	80,00	80,000	366,000	Government	National budget
Improving information dissemination	Collection, exchange and dissemination of information	10,000	10,000	10,000	10,000	10,000	50,000	NAIS	National budget
	Provide support to the Ministry of Agriculture –NAIS[i]	84,000	84,000	84,000	84,000	84,000	420,000	Government	National budget
	Provide support to Livestock Information Management System (LIMS) under (NALEIC).[j]	84,000	84,000	84,000	84,000	84,000	420,000	Government	
									(...)

a Detail description of the roles given in annex table 1.2 below
i Operational costs
i Operational costs

(...) Activity		Cost distribution (USD)					Total investment cost(USD)	Lead agency[a]	Proposed source of funding
		Year 1	Year 2	Year 3	Year 4	Year 5			
Delivering integrated weather and climate advisory services using ICT and existing agricultural extension networks	Disseminating geographically targeted agro-weather information via cell phones	25,000	25,000	25,000	25,000	25,000	125,000	ZMD MoA	National budget Donor funded projects
Total budget		**1,035,000**	**1,299,000**	**1,214,000**	**1,111,000**	**1,051,000**	**5,710,000**		
Component 3: Establishing Integrated Information System for Agricultural Risk Management and EWS[k]									
Establishment of web- based Crop information system	Building technical capacity (national level) (information system set-up)	545,000	545,000	-	-	-	1,090,000	MoA	National budget; Donor support
	Application Software Development and System Integration	-	30,000	-	-	-	30,000	MoA, Policy and Planning Department (ICT) Unit)	National budget; Donor support
	Establishment and Management of Agricultural Information database	-	30,000	10,000	10,000	10,000	60,000	MoA (Agribusiness and Marketing Department)	National budget
Establishment of the Animal Health Information Management System (Early Warning)	Procurement of Hardware and Software	-	1,825,000	-	-	-	1,825,000	MoFL	National budget; Donor support
	Setting up of a Web based Surveillance System	1,000,000	300,000	10,000	10,000	10,000	1,330,000	MoFL	National budget; Donor support
	Monitoring and Supervision of Information Management System	234,000	234,000	234,000	234,000	234,000	1,170,000	NALEIC	National budget; Donor support
EWS development and enhancement connectivity	Strengthening the delivery of hydromet and early warning services	25,000	40,000	90,000	90,000	25,000	270,000	ZMD	National budget; Donor support
Total budget		**1,804,000**	**3,004,000**	**344,000**	**344,000**	**279,000**	**5,775,000**		
Overall Investment Plan Budget		**3,375,500**	**5,313,500**	**2,216,500**	**1,773,500**	**1,663,500**	**14,312,500**		

k A Web based Information System with decentralized data entry and central data analysis and reporting is recommended.

Source: The cost estimated were produced by author with inputs from Zambia Meteorological Department, Disaster Management Mitigation Unit, Ministry of Fisheries and Livestock and Ministry of Agriculture.

4.3. Cost-benefit Analysis

An economic analysis comparing both investment costs and benefits of the proposed investment plan has been undertaken to estimate the value of improving access to agricultural risk information in Zambia. The objective of the cost-benefit analysis (CBA) is to verify the economic justification for the proposed investment plan. It has been established that to improve access to agricultural risk information for meso-level operators, investments will be required in modernizing data collection and dissemination infrastructure, enhancing institutional and technical capacity building and establishing and integrated web-based information system. The summary of costs and benefits are presented in table 9.

Table 9: Summary of Costs and Benefits of the proposed investments

Components	Modernizing infrastructure for data collection and dissemination	Enhancing technical skills and institutional capacity	Establishing web-based Integrated Information System for Agricultural Risk Management and EWS
Benefits	• Enable accurate and timely collection of information from areas which are difficult to reach • Use of ICT infrastructure will reduce the cost of collecting, storing, processing and disseminating the information • Improve dissemination channels through which farmers access risk information to support their decision making • Improve coordination of information flow and data collection across key stakeholders.	• Improve delivery of accurate analysis and interpretation of data • Enable accurate disease forecasting, monitoring, and control • Provide decision-making support systems to the government. • Provide needs-based information to research, extension agencies and farmers ensuring the use of modern information products.	• Enable access to timely information which is essential for managing risks • Cost effective one stop shop for all information needs • Enforce collaboration among the key relevant ministries • Improve linkages with private and financial sectors. • Improve access to agricultural (crop and livestock) markets and insurance services. • Monitoring of the performance of Zambia's agricultural infrastructure networks.
Investment Cost	**USD 2,827,500**	**USD 5,710,000**	**USD 5,775,000**

The benefits above will help reduce losses in agriculture that are currently at about 4% of agriculture GDP. An AIS will contribute to a reduction of losses, among other efforts. Two approaches were combined to estimate the benefits from the investment: the i) benchmarking approach and ii) the benefit transfer approach.

4.3.1. Benchmarking approach for estimating benefits of improved ARM services

The benchmarking approach was used to estimate the order-of-magnitude benefits of reducing damages from weather-related events resulting from the adoption of the integrated weather and market information services. Typically, benchmarking is carried out by first using data and estimates from other countries and expert judgment to define and adjust two benchmarks for each country: a) the average annual direct economic losses caused by weather-related hazards as a share of GDP; and b) the potential changes in annual losses with modernization of weather services as a percentage of the total level of losses. In a second step, these factors may be adjusted to account for country-specific estimates of weather and climate conditions, structure of the economy and other factors. These factors are a function of the weather dependency of the economy (vulnerability factor), and the potential reduction in asset damages resulting from the installation of improved weather services (loss reduction factor).

Applying the benchmarking approach to Zambia, yielded the factor and estimates in table 4.4. Zambia is highly vulnerable to droughts and floods with average annual direct economic losses caused by weather and related hazards as a share of GDP estimated at 1%[20]. A conservative estimate of 20% reduction in annual economic damages with modernization of weather services was assumed. This excludes other benefits such as protection of life in impending hazardous conditions.

20 https://www.adaptation-undp.org/sites/default/files/downloads/zambia_project_document.pdf

Table 10: Benchmarking calculation of benefits from improved information services

GDP	$25.8 billion
Vulnerability factor	1%
Loss reduction factor	20%
Benchmarking benefit estimate (national)	$51.6 million
Benchmarking benefit estimate for agricultural sector at 7.2%	$3.7 million

Source: Author's calculation. Agriculture currently contributes 7.2% to national GDP.

As shown in table 10, the top down benchmarking estimate indicates a potential annual value of improved weather services of US$51.6 million/year in Zambia, corresponding to $3.7 million to the agricultural sector alone.

4.3.2. Benefit transfer approach for estimating benefits of improved ARM services

For the benefits transfer approach, the results of contingent valuation of weather services in Mozambique were transferred, correcting and adjusting for the Zambian context (Lazo, 2015). Contingent Valuation is a method of valuing nonmarket goods and services. It entails estimating the value that a person places on the goods or services by asking people to directly report their willingness to pay (WTP) to obtain the specified good or services, rather than inferring them from observed behaviors in regular market places. Table 11 illustrates the conversion of per-household willingness to pay (WTP) to Zambia from Mozambique using simple income ratios and then aggregating to national benefit estimates.

Table 11: Conversion of Mozambique Contingent Valuation Parameters to Zambia context

	Lower	Middle	Upper
Mozambique annual WTP (US $)	0.53	1.16	2.62
GDP per capita (current US dollar)			
Mozambique (2013)	605.98	605.98	605.98
Zambia (2013)	1850.79	1850.79	1850.79
Income ratio: Zambia vs Mozambique (2013)	3.05	3.05	3.05
Adjusted Zambia annual WTP	1.62	3.54	7.99
Number of households	3,366,883	3,366,883	3,366,883
Zambia National annual WTP (US$)	5,454,351	11,918,766	26,901,395

Source: Author's estimation. GDP per capita figures were taken from the World Bank Development Indicators. Number of households in Zambia in 2010 also available in World Bank Open Data website was projected to current values using a population growth rate of 3.3%

The income ratio conversion from Mozambique to Zambia using per capita GDP estimates yields a Zambian WTP estimate for weather services improvement equal to US$3.54 (US$1.62–US$7.99; 95 percent confidence interval). This is taken as a per-household estimate aggregated across all households (3,366,883) to get a national benefit estimate for the investment with a central estimate of US$11.9 million/year.

4.3.3. Cost-benefit Analysis Assumptions and Results

For all calculations, real values are applied that do not factor in inflation or potential changes in exchange rates. A discount rate of 12 percent suggested by World Bank guidelines for economic analysis was applied. It was assumed that the total project implementation occurs over a five-year period as indicated in table 4.2. Some 50 percent of investment costs will be used for equipment. Thus, the analyses used 50 percent of project cost as the base for calculating 10 percent of depreciation. Given that operations and maintenance costs were included in the project costing, the analyses provided for 15 percent annual operation and maintenance expenses of 50 percent of investment costs beginning from year 6 of the 20-year project analysis period. A CBA for a period of 20 years was conducted given the fact that benefits of the integrated weather and market information systems will be realized over a period much longer than the 5-year project period if the ongoing costs for operations and maintenance, and depreciation are met. It is assumed that project benefits will begin to be realized from year 3 when all the components should be fully functional. Some 60% of benefits are assumed to be realized in year 3, increasing to 80% in year 4, and 100% from year 5 and thereafter.

A net present value (NPV) of US$61.4 million and a cost-benefit ratio (CBR) of 3.7 indicate that the project is economically viable (table 12). The present value of benefits is US$83.9 million, whereas the present value of costs is US$22.5 million, using a time horizon of 20 years for the project and a 12 percent discount rate.

Table 12: Cost- Benefit Calculations of the Investment Plan

	US $ million
Total Present Value – Benefits	US$ 83.9
Total Present Value – Costs	US$ 22.5
Net Present Value (NPV)	US$ 61.4
Benefit-Cost Ratio	3.7

Source: Author's estimation

To test the robustness of the economic and financial analyses, a sensitivity analysis was conducted using (a) lower and upper bound WTP estimates; and (b) alternative discount rates (6 and 15 percent). Table 13 shows that using a lower bound WTP estimate generates a lower NPV and BCR compared to the baseline. Applying, a higher bound benefit estimates resulted in higher NPV and the highest BCR of 7.3. This upper bound possibly represents the upper limit of the investment value in Zambia. Applying a lower discount rate yielded higher NPV and BCR compared to the baseline. However, this does not change the overall conclusions concerning the financial viability and desirability of the investment.

Table 13: Sensitivity analysis with alternative investment variables

		Alternative WTP estimates		Alternative discount rates	
	Baseline	Lower	Upper	Lower	Higher
Annual benefits Benchmarking (US$ million)	3.7	3.7	3.7	3.7	3.7
Annual benefits WTP (US$ million)	11.9	5.4	26.9	11.9	11.9
Discount rate (%)	12	12	12	6	15
Total Present Value – Benefits US$ million	83.9	49.2	164.3	142.9	66.5
Total Present Value – Costs US$ million	22.5	22.5	22.5	32.6	19.4
Net Present Value US$ million	61.4	26.7	141.8	110.3	47.1
Benefit Cost Ratio	3.7	2.2	7.3	4.4	3.4

Source: Author's estimation

4.4. Sustainability of the investment

Ex post funding by most governments in developing countries and international agencies has been the major response to catastrophic losses. However, this approach turns out to be ineffective, inefficient and insufficient (Mahul & Skees, 2007). There has been less interest by governments in ex ante management of risks because of the perceived low levels of vulnerability and the fact that most severe hazards manifest themselves very infrequently. Thus, governments generally adopt reactive approaches to natural disasters, relying on domestic budgets, and on extensive financing from international donors (World Bank, 2017).

Therefore, sustainability of the investment plan presented here is an issue. In the past, several projects have come to an end after funding from the donor seizes. In addition, most of the donor support is on pilot basis reaching only specific districts. This significantly limits the information collected and compromises the quality of data. Added to the limited district coverage is the fact that target data such as commodities, level, and districts covered are inconsistent over time. With such inconsistences, the system clearly does not provide the timely, agriculture information (production, marketing, prices, climate risks) that the end users and policy makers require.

While the sensitivity analyses demonstrate the robustness of the investment to changes in discount rate and benefit rates, the sustainability of the investment will largely depend on government's commitment to mainstream agricultural risk management into the agricultural planning framework and national budget. Continuous support of the initial investment in terms of operations and maintenance costs and skills development are crucial for the realization of full benefits from the system.

References

Alemu D., De Groote H.,and Bacha D. The Role of Market Information System in Improving Rural Livelihood and the Status of the Service in Ethiopia https://repository.cimmyt.org/xmlui/bitstream/handle/10883/2129/89782.pdf?sequence=1&isAllowed=y

CCAFS. Info Note. Impact of climate change on African agriculture: focus on pests and diseases https://cgspace.cgiar.org/rest/bitstreams/55241/retrieve

CCAFS. Info Note: Improving Early Warning Systems for Agricultural Resilience in Africa

COMCEC. Improving Agricultural Market Performance: Developing Agricultural Market Information Systems http://www.sbb.gov.tr/wp-content/uploads/2018/11/Improving_Agricultural_Market_Performance_Developing_Agricultural_Market_Information_Systems%E2%80%8B.pdf

Dorosh. A., Dradri S., and Haggblade S.: Alternative Approaches for Moderating Food Insecurity and Price Volatility in Zambia. http://www.iapri.org.zm/templates/iapr/pdf/ps24.pdf

ESA Specialist Panel. Satellite radar in Agriculture https://earth.esa.int/documents/10174/1598482/GEN25.pdf

Government of Republic of Zambia National Budget (2018), Ministry of Agriculture, 2019 Budget

Government of Republic of Zambia (2013), Zambia National Agriculture Investment Plan (NAIP) 2014-2018

Global Yield Cap Atlas http://www.yieldgap.org/zambia

Global Yield Cap Atlas http://www.yieldgap.org/zambia

Grain Marketing Innovations and Investments in Zambia: Creating Marketing Opportunities for Smallholder Farmers

FAO. (2017). Building Agricultural Market Information Systems: A literature review. Rome. Milovanović, S. (2014). THE ROLE AND POTENTIAL OF INFORMATION TECHNOLOGY IN AGRICULTURAL IMPROVEMENT. Economics of Agriculture 2/2014, 471-485.

IAPRI. Getting It Right: How to Make Grain Trade Work for Zambia

IFC. Access to Finance for Smallholder Farmers: Learning from the Experiences of Microfinance Institutions in Latin America https://www.ifc.org/wps/wcm/connect/071dd78045eadb5cb067b99916182e35/A2F+for+Smallholder+Farmers-Final+English+Publication.pdf?MOD=AJPERES

Lazo, J. K., 2015: Survey of Mozambique Public on Weather, Water, and Climate Information. NCAR Technical Note NCAR/TN-521+STR, 236 pp, doi:10.5065/D6B56GS4.

Mahul, O., & Skees, J. (2007). Managing Agricultural Risk at the Country Level: The Case of Index-Based Livestock Insurance in Mongolia. Policy Research Working Paper 4325.

PARM. (2017). Information Systems for Agricultural Risk Management: Better information. Enhanced risk management. More investment in agriculture. Rome - Italy: IFAD HQ,.

Pertev R. The role of farmers and farmers organizations. http://om.ciheam.org/om/pdf/c02-4/94400041.pdf

Ramasamy Selvaraju R. Climate Risk Assessment and management in Agriculture http://www.fao.org/docrep/017/i3084e/i3084e06.pdf

Röling, N. G. (1988). Extension Science. Information System in Agricultural Development, Cambridge University Press, Cambridge.

Poongodi, B., Lopoyetum S. K., Muthulakshmi, A.P. E-Agribusiness with special reference to Agricultural Marketing Information Network AGMARKNET. https://www.researchgate.net/publication/305379972_E-Agribusiness_with_special_reference_to_Agricultural_Marketing_Information_Network_AGMARKNET

Technical Centre for Agricultural and Rural Cooperation (CTA) . (2007). Assessment of Agricultural Information Needs in African, Caribbean & Pacific (Acp) States: Country Study: Zambia .

UNDP. Climate heroes bridge gaps in Zambia. https://medium.com/@UNDP/climate-change-fighters-in-zambia-a91d2d2c284e

USAID. Policy Brief: Zambia's Agricultural Marketing Information Centre http://eatproject.org/docs/USAID-EAT%20Policy%20Brief%20Zambia%20AMIC.pdf

Vision 2030 for Zambia http://unpan1.un.org/intradoc/groups/public/documents/cpsi/unpan040333.pdf

Weather Data to Weather Forecasts for Zambian Farmers http://ictupdate.cta.int/2018/05/24/weather-data-to-weather-forecasts-for-zambian-farmers/

World Bank. 2017. Assessment of Food Security Early Warning for East and Southern Africa http://documents.worldbank.org/curated/en/454781516290787924/pdf/122857-ESW-P161298-PUBLIC.pdf

World Bank. Module 11: ICT Applications for Agricultural Risk Management http://fr.afraca.org/download/general_rural_finance_publications/ICT-Applications-for-Agricultural-Risk-Management-By-Soham-Sen-and-Vikas-Choudhary.pdf

World Bank. Climate Information Services in Kenya http://documents.worldbank.org/curated/en/706021467995075539/pdf/103186-REVISED-PUBLIC-AG-GP-TAP-CIS-Providers-in-Kenya-WEB-02292016.pdf

World Bank, 2018. Increasing Agricultural Resilience through Better Risk Management in Zambia. http://documents.worldbank.org/curated/pt/330211524725320524/pdf/125784-WP-25-4-2018-9-34-36-ZambiaAgResilienceRiskMgtweb.pdf

World Bank. 2017. Increasing Agricultural Production and Resilience Through Improved Agro-Meteorological Services http://documents.worldbank.org/curated/en/246621468167041502/pdf/944860WP0P12750vices0Web00301102015.pdf

Zambia's Agricultural Marketing Information Centre Policy Brief:
http://eatproject.org/docs/USAID-EAT%20Policy%20Brief%20Zambia%20AMIC.pdf

Zambia Food Reserve Agency. Pricing Mechanisms and the Impact on Maize Markets.
https://www.researchgate.net/publication/308644983_Zambia_Food_Reserve_Agency_Pricing_Mechanisms_and_the_Impact_on_Maize_Markets

Zambia National Agriculture Investment Plan (NAIP) 2014-2018 Under the Comprehensive Africa Agriculture Development Programme (CAADP)
http://extwprlegs1.fao.org/docs/pdf/zam169508.pdf

Zambia Vulnerability Assessment Committee. 2018/2019 National Contingency Plan.

Zhang , Y., Wang, L., & Duan, Y. (2016). Agricultural information dissemination using ICTs: A review and analysis of information dissemination models in China. INFORMATION PROCESSING IN AGRICULTURE 3, 17–29.

(2017). Retrieved from InfoBridge Foundation:
http://www.infobridge.org/home/index.php/about-us/telecentresafrica/partner-activities/285-icts-and-agricultural-information-service-delivery-experiences-in-rural-zambia

InfoBridge 2017. ICTS and Agricultural Information Service Delivery – experiences in Rural Zambia
http://www.infobridge.org/home/index.php/about-us/telecentresafrica/partner-activities/285-icts-and-agricultural-information-service-delivery-experiences-in-rural-zambia

NOTES

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PLATFORM FOR
AGRICULTURAL RISK
MANAGEMENT

Annexes

A1. Logical framework

Objectives and Activities	Indicators	Means of Verification	Assumption
Goal: To develop recommendations and a corresponding investment plan for early warning and information system(s) to help meso-level operators in agriculture and smallholder farmers better manage risks related to weather and climate variability, pests and diseases, and price volatility.	**Indicator 1**: Identified and analyzed information needed to enable meso level operators to better manage market risks, particularly related to price volatility, production risks and weather and climate hazards. **Indicator 2**: Mapped relevant existing initiatives e.g. information systems) including relevant roles and responsibilities, financing sources, data used, systems used, dissemination channels, end users etc **Indicator 3**: Analyzed reliability of those information categories (related to production and market risks) regarding their timely dissemination, sources used, quality (e.g. level of disaggregation, verified accuracy, gaps), and end-user usefulness. **Indicator 4**: Analyzed institutional capacities and coordination modalities of the various agencies already or to be involved in capturing, processing, storing, monitoring, distributing, and using agricultural information, relevant for managing production, and market risks. **Indicator 5**: Analyze the needs and capacities of the meso level stakeholders to access to relevant, high quality information in usable formats in a timely way, understand and use it. **Indicator 6**: Analysis of current dissemination mechanisms for existing information related to production, market risks	Feasibility study	This is an evolving, dynamic process
			(...)

(...) Objectives and Activities	Indicators	Means of Verification	Assumption
Purpose: To make the agricultural risk and early warning information available and accessible in a timely manner for the meso level users in the agricultural value chain and smallholder producers.	Indicator 1: Improved infrastructure for weather data collection at ZMD. Indicator 2: Improved internet connectivity, through installation of communication towers across the country in rural areas Indicator 3: Improved collection of agricultural data at all levels Indicator 4: Technical and institutional capacities of key government agencies and departments enhanced Indicators 5: Provision of appropriate ICT infrastructure for data collection, processing and storage Indicator 6: Improved information dissemination Indicator 7: An integrated weather and climate advisory services using ICT and existing agricultural extension networks delivered Indicator 8: Web- based Crop information system established Indicator 9: Animal Health Information Management System (Early Warning) established Indicator 10: EWS developed and enhanced connectivity	Impact Surveys	There will be continued and sufficient demand for agricultural risk and EWS information. Unlikely disruption by political or civil unrests Retention of trained staff from key institutions.
Outcome: To increase access to quality, accurate and timely agriculture risk and early warning information for increased agricultural production and productivity	Increase in quality, accurate and timely agricultural risk and early warning information. Increase in agricultural production and productivity	Impact surveys Reports and records from stakeholders	
Outputs: 1. Modernized infrastructure for data collection and dissemination 2. Enhanced technical skills and institutional capacity 3. Established Integrated Information System for Agricultural Risk Management and EWS	Improved agricultural risk information for meso-level operators		

A2. Action plan

Improving Agricultural Risk Information For Meso-Level Operators In Zambia				
Objective	**Recommended Action**	**Responsibility**	**Indicators**	**Completion Date**
Modernizing infrastructure for data collection and dissemination	1. Procurement of Automatic weather station, one server and a license 2. Procurement of Automatic Rainfall station, server and license 3. Procurement of downscaling hardware/ tool 4. Procurement of downscaling software 5. Upgrading of 77[a] existing agro- meteorological stations to improve data collection and geographic coverage 6. Upgrading ICT infrastructure at national and provincial offices 7. Provision of Internet Services 8. Procurement of tablets for extension officers 9. Provision of internet services for field staff 10. Development of GIS and remote sensing facility at provincial HQs in all 10 provinces (to promote the use of remote sensing/satellite for data collection to cover remote areas)	ZMD	1. Improved infrastructure for weather data collection at ZMD 2. Improved internet connectivity, through installation of communication towers across the country in rural areas 3. Improved collection of agricultural data at all levels	December 2024
Enhancing technical skills and institutional capacity.	1. Training of staff in data collection and analysis 2. Strengthen Institutional capacity (training, AWSs/ radars O&M, and so on) 3. Strengthen technical capacity (human resources capacity building) 4. Strengthen extension systems in MoA, MoFL Strengthen risk management and disaster mitigation capability 5. Provision of IT equipment and operations and maintenance budgets 6. Provision of IT equipment and operations and maintenance budgets 7. Provide support to the Ministry of Agriculture –NAIS 8. Provide support to Livestock Information Management System (LIMS) under (NALEIC). 9. Disseminate geographically targeted agro-weather information via cell phones	ZMD, MoA, DMMU, MoFL Government, NAIS	1. Enhanced institutional capacity building for key government agencies and departments such as ZMD; DMMU; Department of Agriculture and the Early Warning Unit within the MoA, the NALEIC within Ministry of Fisheries and Livestock (MoFL), among others 2. Appropriate ICT infrastructure for data collection, processing and storage provided 3. Improved information dissemination 4. An integrated weather and climate advisory services using ICT and existing agricultural extension networks delivered	December 2024
Establishing a web-based Integrated Information System for Agricultural Risk Management and EWS.	1. Build technical capacity (national level) (information system set-up) 2. Application Software Development and System Integration 3. Establishment and Management of Agricultural Information database 4. Procurement of Hardware and Software 5. Setting up of a Web based Surveillance System 6. Monitoring and Supervision of Information Management System 7. Strengthening the delivery of hydromet and early warning services	MoA (Agribusiness and Marketing Department), MoA, Policy and Planning Department (ICT) Unit), MoFL, NALEIC and ZMD	1. Web- based Crop information system developed 2. Animal Health Information Management System (Early Warning) established 3. EWS developed and enhancement connectivity	December 2024

a Of which 38 are automatic and 39 are manual.

A3. List of some existing initiatives/projects to leverage on

Implementer	Project Name	Area of Collaboration	Financier/donor
Ministry of Agriculture	Building Resilience and Adding Value to Agriculture (BRAVA) Programme	The project will focus on sustainably increasing the production and productivity of smallholder farmers and the resilience of agricultural systems.	IFAD, OPEC Fund for International Development (OFID), Arab Fund for Economic Development in Africa (BADEA), GRZ, Private Sector and GCF.
UNDP	Strengthening Climate Resilience of Agricultural Livelihoods in Agr0-ecological Regions I and II in Zambia	The project is focused on strengthening climate resilience of agricultural livelihoods in the following districts: Mambwe, Nyimba, Chongwe, Luangwa, Chirundu, Rufunsa, Chama, Mafinga, Kazungula, Siavonga, Gwembe, Namwala, Shangombo, Senanga, Sesheke and Mulobezi.	GCF
UNDP	Strengthening Climate Information and Early Warning Systems for Climate Resilient Development	The project is focused on strengthening the capacity of national and sub-national entities to monitor climate change, generate reliable hydro-meteorological information (including forecasts) and to be able to combine this information with other environmental and socio-economic data to improve evidence-based decision-making for early warning and adaptation responses as well as planning.	The Least Developed Countries Fund (LDCF)
ZMD	Climate Information and Early Warning Systems (CIEWS)	This project aims to increase the geographic coverage of the Meteorological observation network in Zambia and activate communication channels for disseminating severe weather warnings, as well as to implement two-way community based early warning systems in three-flood and drought-prone districts, namely Gwembe, Mambwe and Sesheke.	
DMMU	Zambia Strengthening Climate Resilience (PPCR Phase II)	Two-way early warning system (EWS) established and operational	World Bank

A4. Key stakeholders involved and their respective roles

Stakeholder	Relevant roles
Government Ministries and agencies	
Disaster Management and Mitigation Unit	Provide early warning to national stakeholders
Zambia Meteorological Department (ZMD)	Collect, analyse and disseminate EWS information,
Zambia Agricultural Research Institute (ZARI)	Collect information on new technologies, and conduct research to inform response to agricultural risks
Ministry of Agriculture (MoA)	Provide overall guidance and coordination of the integrated agricultural risk information system
Department of Agriculture, MoA	Provide technical support for extension and field staff; Collect and analyse information on agriculture risks
Department of Agribusiness and Marketing (MoA)	Provide marketing information on all commodities
Early Warning Unit (MoA)	Produce production data through conducting Crop Surveys
Information Communication and Technology (ICT) Unit (MoA)	Management of Information System
Agribusiness and Marketing Department (MoA)	Management of agriculture marketing information
National Agriculture Information Services	Information Provision and Dissemination through community radios
Zambia Information & Communications Technology Authority (ZICTA)	Regular of communication providers
Ministry of Transport and Communication	ICT infrastructure and improving connectivity
Private sector/ Farmer organisations	
Zambia National Farmers Union (ZNFU)	Play a critical role in dissemination of information.
National Union of Small Scale Farmers Zambia	Play a critical role in dissemination of information.
Input suppliers particularly agro-dealers	Play a critical role in dissemination of information and provision on input
International Organizations	
AfDB	Financial support to investment and technical assistance
World Bank	Financial support to investment and technical assistance
European Union	Financial support to investment and technical assistance
USAID	Financial support to investment and technical assistance
Germany Development Corporation; GIZ	Financial support to investment and technical assistance
UNDP	Financial support to investment and technical assistance
FAO	Financial support to investment and technical assistance
DFID	Financial support to investment and technical assistance
IFAD	Financial support to investment and technical assistance
WFP	Financial support to investment and technical assistance

Note: The investment plan has identified these public and private sector actors including the development partners listed against their roles and responsibilities as key in the realisation of the actions recommended to improve access to information for meso-level stakeholders.

A5. List of stakeholders met

No	Name	Title	Organization
1	Nalishebo Meebelo	PARM Liaison Officer	PARM
2	Cecil Nundwe	Water sector specialist	World Bank
3	Alex Mwanakasale	Agricultural Specialist	World Bank
4	Ademola Braimoh	CSA Africa Coordinator	World Bank
5	Henry Sichembe	Private Sector Specialist	World Bank
6	Mr. Lenganji Sikaona		Disaster Management and Mitigation Unit (DMMU)
7	Mr. Lusajo Ambukege	GIS Expert	DMMU
8	Mr. Steven Chanda		Water Resources Management Authority (WARMA)
9	Mr. Kwibisa Liyalii	E-SAPP/IFAD Project Coordinator	Ministry of Agriculture (MoA)
10	Mr. Elemson Muyanga	Grant Management Officer, E-SAPP	MoA
11	Mr. Mulenga Emmanuel	Agribusiness Manager, E-SAPP	MoA
12	Mr. Emmanuel Sikana	Assistant Director, Forecasting and Research	Zambia Meteorological Department (ZMD)
13	Mr. Matakala Mushimbei		ZMD
14	Mr. Chitalu Zimba		Ministry of Agriculture
15	Dr. Antony Chapoto	Research Director	IAPRI
16	Harriet Mweene	MoA focal point for PARM	MoA
17	Dick Siame	IFAD Country Officer	IFAD
18	Mr. Humphrey Mulele	Manager Agricultural Specialties	Mayfair Insurance
19	Dr. Ricky Chazya	Senior Epidemiologist,	National Livestock Epidemiology Centre, Ministry of Fisheries and Livestock
20	Mr. Masiye Nawiko	Executive Director	Agricultural Consultative Forum
21	Allan Mulando		World Food Programme (WFP)
22	Lewis Bangwe		Africa Development Bank, Zambia
23	Ms. Julia Kirya		GIZ
24	Mr. Michal Kielar		Germany Development Corporation
25	Memory M. Hamukombo Phiri	MFL/Livestock Production Officer	MFL-Lusaka
26	Chewe Kamunga	MOA/Information Officer	MOA-Lusaka
27	Raphael Mazonga	MoA - Crops	MOA-Lusaka
28	Jane Muchabi Kabunda	MoA-Senior Agriculture Officer	MOA-Lusaka
29	Agnes P. Changala	MoA – Ag Extension Methodologist	MOA-Lusaka
30	Noreen Mulambia Chanda	MoA-District Marketing Development Officer	MOA-Lusaka
31	Charity R. Mutale	MoA-Ag Crops Officer	MOA-Lusaka

No	Name	Title	Organization
32	Wisford Mudenda	Social Capital Development & Training Manager	Heifer
33	Moses Mwale	Director	Zambia Agriculture Research Institute
34	Wisdom S.Mubiana	Branch Manager, Chipata	Professional Insurance
35	Patrick Njobvu	Cotton Inspector	Cotton Board of Zambia
36	John M. Zulu	Relationship manager/Commercial banking, Chipata Branch	Zanaco
37	Chakwana P. Kalima	Regional Relationship Manager – Public Sector banking	Zanaco
38	Abdul Waheed Ahmed		JTI (Agrodealer)
39	Philip Siamuyoba	Chief Agricultural Officer - Agronomy	MoA
40	James C. Kasongo	Board Secretary/CEO	Tobacco Board of Zambia
41	Morgan Simbeya	Regional Tobacco Inspector	TBZ, Chipata
42	Friedrich Mahler	Agriculture & Rural Development Advisor	European Union
43	John Stanley		EU
44	Chinyanta Kambole	Extension Methodologist	MoA Chipata
45	Brennan Wamututa	officer	Community Development
46	Davy Munthali		MoA
47	Imbuwa Mushebwa	DACO	MOA
48	Samuel Mwenya		MFL
49	Mbaulu Godwell		MOA
50	Innocent Mainza	District Officer	MET/ZMD
51	Kelvin Mutelo		MOA
52	Greenwell Sichone	AGRODEALER	
53	Lister Chifuwe	Farmer	Gwembe
54	Milimo Philimon	Farmer	Gwembe
55	Peter Macasa	Farmer	Gwembe
56	Mary Habongwe	Farmer	Gwembe
57	Dominic H. Syasunka	Farmer	Gwembe
58	Hamooya Goliath	Farmer	Gwembe
59	Kabilika Sylvester	Farmer	Gwembe
60	Mouyumbwe Obby	Farmer/Headman -Gwembe	Gwembe
61	Constantine Mukotolo	Farmer/Headman -Gwembe	Gwembe
		Farmers	Chipata

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PLATFORM FOR AGRICULTURAL RISK MANAGEMENT

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