Development of print and multimedia learning resources to support climate-smart school gardens, curriculum integration and agri-entrepreneurship promotion in rural South African primary schools

Final report to the Water Research Commission

By

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LIST OF ABBREVIATIONS

CAPS	Curriculum and Assessment Policy Statement
CSA	Climate-Smart Agriculture
CMF	Curriculum Mapping Framework
DoE	Department of Basic Education
EMS	Economic and Management Sciences
LS	Life Skills
NS	Natural Sciences
NGOs	Non-Government Organisations
OMF	Old Mutual Foundation
PPT	PowerPoint Presentation
UMP	University of Mpumalanga
WRC	Water Research Commission

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EXECUTIVE SUMMARY

The Water Research Commission (WRC) and Old Mutual Foundation (OMF), in partnership with the University of Mpumalanga (UMP), implemented a research and development initiative titled *"**Demonstrating climate resilience in four rural schools with limited water availability by enhancing food and nutrition security through innovation and science transfer**".* The project was carried out in four rural primary schools, namely: Mxaka (Eastern Cape Province), Boaramelo (Free State Province), Divhani (Limpopo Province), and Thandanani (Mpumalanga Province), located in water-stressed rural communities of South Africa. These schools face multiple intersecting challenges, including limited access to water, poor soil conditions, climate variability, and constrained resources for practical learning. In response, the project sought to improve climate resilience, enhance food and nutrition security, and strengthen agricultural learning through the establishment and integration of climate-smart school food gardens.

This Executive Summary presents an overview of Deliverable 5, which focused specifically on designing, producing, and arranging print and multimedia learning resources to support climate-smart agriculture (CSA) practices, promote curriculum integration, and foster early-stage agri-entrepreneurship among primary school learners. The materials developed include high-quality posters, infographics adopted when doing the training, pocket guides used, and short how-to instructional videos. Together, these tools form a comprehensive educational package designed to reinforce practical learning, strengthen teacher capacity, and enhance long-term garden sustainability.

The materials simplify scientific gardening concepts, support hands-on learning, and cultivate an early entrepreneurial mindset. Designed in child-friendly, visually engaging formats, the resources serve teachers, learners, and community members, fostering long-term sustainability of school gardens and strengthening climate-resilient food systems in rural South Africa.

CHAPTER 1: INTRODUCTION

1.1 Background and Purpose

Climate change continues to threaten food systems globally, and its effects are evident across South Africa through prolonged droughts, erratic rainfall, and rising temperatures (Nkosi, Olorunfemi & Khwidzhili, 2023). As the country works toward achieving Sustainable Development Goal 2 (Zero Hunger), strengthening local food solutions, especially school food gardens, is essential (May, Witten & Lake, 2020). South Africa is a water-scarce country, with much of the nation receiving less than 500 mm of rainfall per year (Araya et al., 2020). Such that rural communities and schools require adaptive agricultural practices that conserve water, improve soil health, and encourage sustainable food production. Hence, school food gardens provide a practical platform for teaching Climate-Smart Agriculture (CSA) principles while simultaneously improving nutrition outcomes, reducing dependence on external food supplies, and strengthening community resilience.

In rural communities where the project beneficiary schools, namely: Thandanani, Mxaka, Divhani, and Baoramelo schools are located, the implementation of CSA techniques is particularly vital due to challenges such as water scarcity and the urgent need for increased agricultural productivity. The identified CSA techniques that tend to be practiced include mulching, composting, water-saving irrigation, soil testing, and improved soil management equip learners with important agricultural skills relevant to future livelihoods. School gardens also function as practical learning laboratories, promoting agricultural literacy, nutrition awareness, environmental responsibility, and entrepreneurship. Research highlights that early exposure to agriculture can positively influence youth attitudes and increase participation in agri-preneurship (Magagula & Tsvakirai, 2019). Strengthening this exposure at the primary school level builds a strong foundation for lifelong learning. This project recognised the importance of integrating Innovation and science-based gardening skills, Curriculum-linked gardening content and Entrepreneurship development**.** These materials were designed to support three interconnected purposes:

1. Establishment of climate-smart school gardens using water-efficient and low-input practices.
2. Integration of gardening activities into the national school curriculum (Curriculum and Assessment Policy Statement - CAPS) through experiential learning.
3. Promotion of agri-entrepreneurship among school learners to shift perceptions of agriculture and stimulate youth-led economic opportunities.

Thus, the development of print and multimedia learning resources was essential to support schools in establishing climate-smart gardens and using them for teaching and economic awareness.

1.2 Deliverable 5 title and description

Deliverable 5 aims were to develop a print and multimedia series of short how-to videos on climate-smart school garden establishment, curriculum integration, and agri-entrepreneurship promotion. This included Posters, Infographics, Pocket guides, Short instructional videos and Explanatory materials for learners and teachers. All materials were developed using outputs from workshops and training conducted in the four beneficiary schools.

CHAPTER 2: LITERATURE REVIEW

DESIGN, PRODUCTION, AND PEDAGOGICAL VALUE OF PRINT AND MULTIMEDIA TOOLS IN ADVANCING CLIMATE-SMART SCHOOL GARDEN INITIATIVES, CURRICULUM INTEGRATION, AND AGRI-ENTREPRENEURSHIP

This section explores the development and use of print media tools (posters, infographics, pamphlets) and audio-visual tools (short how-to-do videos) in supporting climate-smart and school-based gardening. It considers how these tools can embed gardening knowledge into curricula, foster an agri-entrepreneurial mindset among learners, and support the long-term sustainability of established gardens, thereby promoting agricultural and entrepreneurial skills among youth.

2.1 Development of Print and Multimedia Learning Resources

Print media (including posters, infographics and pamphlets) and audio-visual resources (short instructional videos) are widely recognised as effective, low-cost tools for embedding climate-smart gardening within school curricula. These media simplify complex agricultural and environmental concepts such as water-wise irrigation (***Appendix A***), essential soil preparation activities done (***Appendix B)*** and basic climate adaptation methods into accessible, repeatable classroom and garden actions, thereby improving learner comprehension and retention (Corrochano et al., 2022; Wahyoedi et al., 2022). As a result, when aligned with the "garden-as-a-living-laboratory" approach, print and video resources transform irregular gardening activities into continuous, curriculum-linked learning experiences that support interdisciplinary outcomes in science, nutrition, environmental education and entrepreneurship (Walshe, Evans and Law, 2024). This also promotes fun, easy learning that enhances agricultural career in the learner's potential for the future.

The print and multimedia learning resources were co-developed through participatory workshops done in the 4 schools as the project beneficiary schools, which involved teachers, learners and parents as community members. All materials were designed to be visually engaging, linguistically simple and technically accurate, ensuring usability for learners from

the three phases, namely the foundation phase, intermediate and senior phase (Grade R to Grade 12). Such that emphasis was deliberately placed on local relevance, low-resource applicability and alignment with the South African Curriculum and Assessment Policy Statement (CAPS), as these dimensions represented the core impact pathway of the project which are ensuring that climate-smart school garden interventions are not only educationally embedded but also directly contribute to school-based nutrition supplementation through the production of fresh, diverse and nutrient-rich foods. This participatory design approach promoted ownership, contextual appropriateness and institutional buy-in, key success factors identified in effective school-garden programmes (Kanosvamhira, 2025).

2.1.1 Posters as Scaffolding Tools for Practical Learning

Posters were developed to serve as continuous reference tools during practical training sessions, where participants actively engaged in hands-on activities based on three core trainings provided to the schools. With visual learning providing appropriate supports, the posters reinforced key scientific concepts, including nutrient cycling, evaporation reduction and soil-water relationships, while simultaneously promoting safe and climate-smart practices suitable for water-scarce environments in line with the project's core objectives (Corrochano et al, 2022; Walshe et al., 2024). Moreover, the integration of entrepreneurial establishment principles further enables learners to understand production not only as a biological process but also as an economic activity with livelihood potential (Nade & Malamsha, 2021).

The posters specifically focused on which were on (1) Nursery establishment, garden layout, crop management and enterprise activities; (2) Integration of gardening activities into the national school curriculum (CAPS) through experiential learning; and (3) Promotion of agri-entrepreneurship among school learners to shift perceptions of agriculture and stimulate youth-led economic opportunities. Using the step-by-step posters that outline the establishment and management of climate-smart school gardens provides an effective, low-cost and accessible means of conveying essential information to learners, teachers and community members as presented by (Wahyoedi et al., 2022). For instance, Figure 2.1 focuses on mulching, composting and safe fertiliser application. Mulching is applied by using

grass, leaves and straw to demonstrate water conservation, weed suppression and soil temperature regulation. The composting application is based on layering of kitchen waste, dry organic matter and soil to promote nutrient cycling and soil health. Lastly, safe Fertiliser application is reinforced through clear warnings against direct application on leaves and stems, promoting safer side-dressing techniques. These visual reinforcements support learner understanding of nutrient cycling and soil-water relationships (Corrochano et al., 2022). Hence, it is essential to develop posters that possess visually engaging resources to simplify complex concepts such as water-efficient production systems, soil health management and climate-resilient practices, making them easier to understand and implement in schools operating under limited water and infrastructure conditions as presented in **Appendix C & D** (Kanosvamhira, 2025).

Figure 2-1: Mulch, Compost and Fertilizer Application

Source: UMP and Gemini AI, 2025

When integrated with curriculum-aligned content, the posters enable teachers to embed gardening, environmental literacy and entrepreneurship into daily classroom activities rather than treating gardens as once-off projects as presented by Figure 2.2. This approach strengthens learners' understanding of agriculture as both a scientific discipline and a viable career pathway, while also reinforcing cross-curricular learning in Natural Sciences, Life Skills and Economic and Management Sciences (Walshe et al., 2024). Moreover, by embedding garden production and entrepreneurship knowledge within the curriculum, these activities become sustained learning experiences that continue year after year, supporting school

nutrition supplementation through the production of fresh, diverse and nutrient-rich foods (Corrochano et al., 2022; Kanosvamhira, 2025).

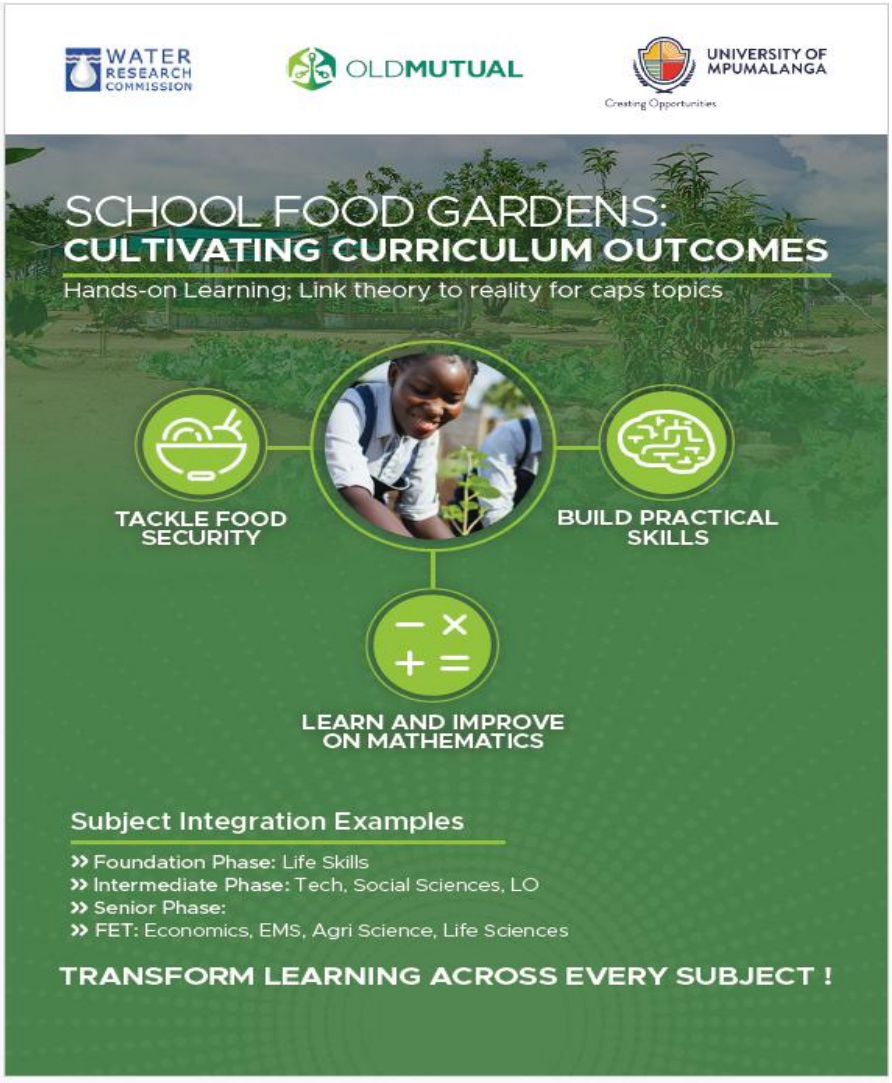

Figure 2-2: Curriculum Mapping poster

Source: UMP and Gemini AI, 2025

Therefore, by equipping learners with practical skills in food production, problem-solving and small-scale enterprise development, the posters contribute directly to the long-term sustainability of school gardens while nurturing a new generation of climate-conscious, food-secure and entrepreneurial youth (Idrissi Boutaybi et al., 2024; Nade & Malamsha, 2021).

2.1.2 Infographics and Pocket Guides as Portable Learning Tools

Infographic-based learning has been shown to significantly improve learner engagement and understanding by presenting information in visually digestible formats, particularly in low-resource and multilingual settings (Wahyoedi et al., 2022). Hence, Infographics and pocket

guides were developed as portable knowledge tools to support just-in-time learning during the workshops and trainings that were conducted at the schools, as they demonstrate both classroom instruction and practical garden activities. These resources well summarise essential climate-smart gardening concepts, such as soil testing in Figure 2.3, into visually structured, learner-friendly formats that facilitate rapid understanding and recall (Corrochano et al, 2022). The material developed brings convenience in terms of its portability, which enables participants, such as learners, to consult the guides directly in the school garden and at home, strengthening the link between theoretical instruction and practical application. As a result, visual learning tools are particularly effective in low-resource and multilingual school environments, where they support inclusive learning and reduce dependence on text-heavy materials (Deng, 2024).

It is worth noting that a Climate-Smart Agriculture (CSA) A5 pocket guide (***Appendix E***) was developed as a portable learning tool for use in both school gardens and home environments. The guide includes instructions on basic soil testing using household materials to determine soil pH and texture, enabling learners to make informed decisions about crop selection and soil improvement. Step-by-step land preparation and transplanting guidance links gardening with mathematics through spacing, measurement and bed layout activities. Such integration strengthens cross-disciplinary learning and supports the treatment of the garden as an additional learning activity of the classroom.

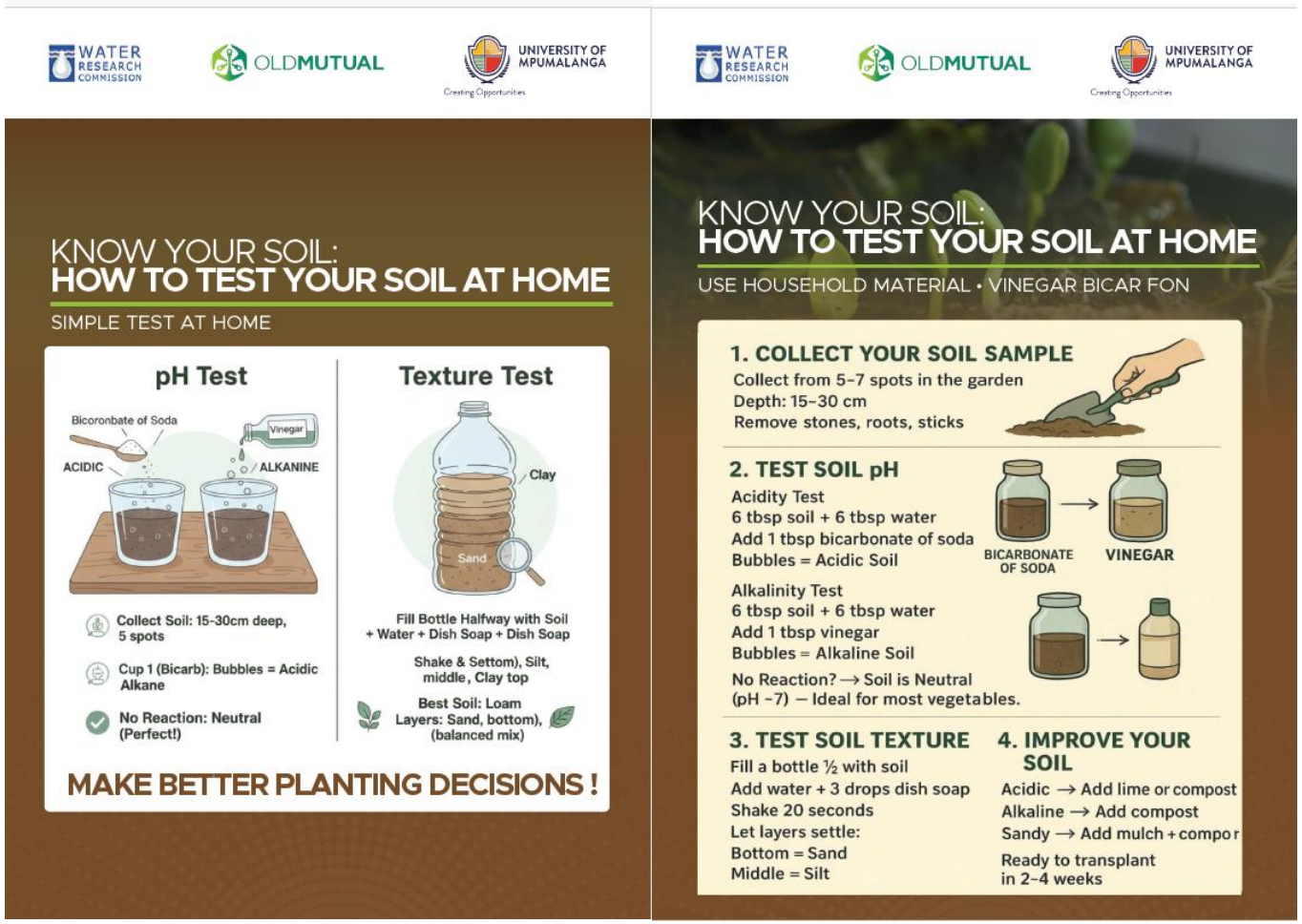

Figure 2-3: Home Soil Ph Testing Posters

Source: UMP and Gemini AI, 2025

2.1.3 Short instructional “How-To” Videos for Inclusive and Skills-Based Learning

A series of short instructional videos was produced to complement the printed materials. These videos demonstrate real learners and teachers performing climate-smart practices such as soil testing, compost preparation, pest control, and garden-based mathematics activities. The videos will be used to support learners with low literacy levels, reinforce step-by-step problem-solving while model best practices in context and lastly strengthen teacher confidence and pedagogical skills. According to Deng (2024), audio-visual materials are especially effective for low-literacy learners and help standardise good practice across multiple schools. Studies show that blended learning approaches combining teacher facilitation with short, targeted videos significantly improve learner engagement and procedural skill uptake when compared to lecture-only methods.

Short instructional videos were produced to demonstrate core applications of the gardening tasks, including nursery establishment, compost construction, soil testing and surplus produce marketing. Collectively, the multimedia materials enhance inclusivity and ensure that knowledge transfer is not limited by reading ability.

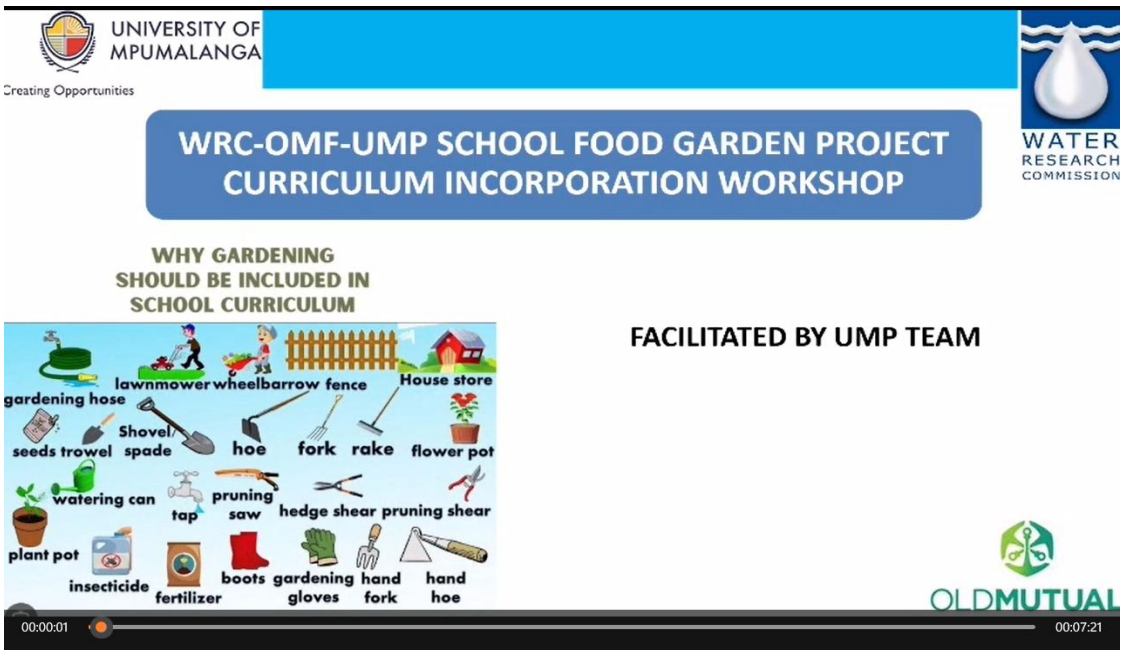

Figure 2-4: Image of the curriculum mapping how-to video

(Source: Curriculum Mapping PPT, 2025)

2.2 Importance of Print and Multimedia Learning Resources

2.2.1 Promoting Agri-Entrepreneurship through Media-Supported Learning

Beyond environmental education, the learning materials deliberately nurture an agri-entrepreneurial mindset. The learning materials introduce foundational entrepreneurial mindset concepts, including problem-solving from "*identify a problem and develop a solution*", for example, having a nursery business as buying seedlings is a challenge identified from the 4 schools which is the potential market niche for the schools and leaners, value-chain thinking via "*from seedling to enterprise*", encompassing production, harvest, marketing and reinvestment), and opportunity orientation by being "*curious, recognise opportunities, solve problems and use resources creatively*" as shown by Figure 2.5. Hence, early exposure of school learners to agri-preneurship has been shown to transform how youth perceive agriculture, repositioning it from a survival activity to a dynamic and viable livelihood option, which is one of the important impacts the projects target the beneficiaries to leverage and obtain. Through the workshops, school learners were actively encouraged to initiate school-based vegetable stalls with frequent fresh vegetable market days, develop value-added products (e.g. dried spinach and chilli powder), and engage in cooperative decision-making. Furthermore, there is exposure on the aspects relating to selling surplus produce, seedling production, processing garden products (e.g. dried herbs) and simple market simulations.

Figure 2-5: Visuals illustrating the mindset concept and entrepreneurship definition.

Source: Gemini AI, 2025

With the agri-preneurhsip trainings that took place in the schools, learners were introduced to basic enterprise concepts such as production planning, costing, pricing and reinvestment through practical school garden activities. Case studies show that structured garden-based enterprise learning significantly increases learners' interest in agribusiness and improves entrepreneurial skills when linked to mentorship and community support structures (Idrissi Boutaybi et al., 2024; Nade & Malamsha, 2021). Embedding entrepreneurship within school garden curricula bridges environmental education with livelihood development pathways.

2.2.2 Media-Supported Curriculum Integration and Sustainability

Formalising garden activities through curriculum mapping, teacher guides and visible print materials institutionalises school garden programmes and reduces reliance on episodic volunteerism. Media tools that emphasise climate-smart practices such as water conservation, composting, crop rotation and indigenous crop promotion have demonstrated to build adaptive capacity in learners and strengthen school-level food security and community resilience (Kanosvamhira, 2025). Additionally, garden activities strengthen learning through:

- Measurement, data collection, and graphing (Mathematics)
- Observation of soil, plants, weather, and ecosystems (Natural Sciences)
- Hygiene, food safety, and nutrition education (Life Skills)
- Market day simulations and budgeting (EMS)

As a result, the combination of print and digital resources ensures continuity of learning and enhances long-term garden sustainability (***Appendix F***).

So, in demonstrating the cultivation of Curriculum Outcomes via the how-to-do video and posters, the project implementing team made use of the Curriculum Mapping Framework (CMF) as it ensures gardening is not an add-on but a core pedagogical tool, enhancing learning across disciplines. The CAPS subjects, including Life Skills, Natural Sciences and Technology, Mathematics, Social Sciences, and Economic & Management Sciences (EMS), as presented in Table 2.1. Hence, this integration transforms the garden into a "living classroom" that supports inquiry-based, problem-solving and project-based learning.

Table 2-1: Curriculum Mapping Framework (CMF) linkage with possible subjects and topics

Grade	Subject	Potential Garden-Linked Topic
R–3	Life Skills (LS)	Healthy eating, caring for living things
4–6	Natural Sciences (NS)	Soil types, plant needs, ecosystems
4–6	Economic and Management Sciences (EMS)	Budgeting, saving, and selling produce
4–7	Mathematics	Measuring plots, calculating yields, and graphing growth

Source: Curriculum Mapping PPT, 2025

2.3 Chapter Summary

Well-designed print and audio-visual learning tools, when aligned with CAPS requirements, teacher training and local market and mentorship opportunities, effectively deliver climate-smart gardening knowledge, foster early agri-entrepreneurial skills and significantly enhance the sustainability and educational impact of school garden programmes. As a result, the developed learning material goes beyond knowledge transfer, as the infographics and pocket guides also function as curriculum integration tools by reinforcing CAPS-aligned content across Natural Sciences (NS), Life Skills (LS), Mathematics and Economic and Management Sciences (EMS). Step-by-step visual guides for land preparation, transplanting, composting and basic enterprise record-keeping promote experiential learning while simultaneously developing numeracy, problem-solving and entrepreneurial competencies (Nade & Malamsha, 2021; Idrissi Boutaybi et al., 2024). By embedding climate-smart production and small-scale enterprise concepts into everyday learning tools, the guides help institutionalise garden-based education, support school nutrition supplementation through consistent food production, and strengthen the long-term sustainability of school garden programmes (Kanosvamhira, 2025).

CHAPTER 3: SUMMARY, CONCLUSION AND RECOMMENDATIONS

3.1 Introduction

The chapter demonstrated how carefully designed educational media can serve as powerful tools to strengthen climate resilience, improve food and nutrition security and foster early entrepreneurial mindsets among primary school learners in water-scarce rural contexts. Hence, a brief summative and conclusion of the report.

3.2 Summary

The learning resources developed under Deliverable 5 achieved their intended purpose of strengthening climate-smart agricultural knowledge transfer, supporting curriculum integration and promoting agri-entrepreneurship among rural primary school learners. The report affirms that media-supported, participatory and curriculum-aligned approaches are essential for building resilient, food-secure and entrepreneurial school communities in South Africa.

3.2.1 Participatory Design and Sustainability of learning material

A key to the project's success was the participatory development approach, which actively involved teachers, learners, and community members in co-designing the learning materials. This collaboration guaranteed the resources were locally and culturally relevant, aligned with the national curriculum (CAPS), and fostered a sense of institutional ownership critical for long-term sustainability. The posters acted as ongoing supports adopting the "*scaffolding*" concepts during training and training provided to the project beneficiary schools, while the portable infographics and pocket guides facilitated immediate, "*just-in-time*" learning. Moreover, the instructional videos further boosted inclusivity, aiding learners with lower literacy and ensuring good practice consistency across different schools.

3.2.2 Integrating Agri-Entrepreneurship and Curriculum

The learning materials were specifically designed to embed agri-entrepreneurship concepts into the gardening activities. Learners gained practical experience in problem-solving, opportunity recognition, costing, pricing, and value-chain thinking through realistic, garden-based enterprise simulations. This crucial shift moved the perception of agriculture from a mere subsistence activity to a viable livelihood pathway, encouraging early youth participation in agribusiness. Furthermore, the use of a Curriculum Mapping Framework (CMF) ensured the school garden functioned as a "living classroom," integrating continuous learning across subjects like Natural Sciences, Mathematics, and Life Skills, which collectively strengthened teacher confidence and the sustainability of the entire food garden program.

3.3 Conclusion and Recommendations

The findings clearly demonstrate that well-designed, context-sensitive and curriculum-aligned print and multimedia learning resources are central to the success and sustainability of climate-smart school food garden initiatives in rural, water-stressed communities. The project successfully translated scientific climate-smart agriculture principles into accessible, practical and learner-friendly tools that strengthened both teaching and learning processes within the beneficiary schools.

The integration of posters, infographics, pocket guides and short instructional videos bridged the gap between theory and practice by enabling learners to apply climate-smart techniques directly in their school gardens. This approach enhanced environmental literacy, promoted responsible natural resource management and improved food production outcomes, thereby contributing directly to food and nutrition security at school and household levels.

Equally significant was the deliberate integration of agri-entrepreneurship into the learning materials. By exposing learners to enterprise concepts such as production planning, marketing, pricing and reinvestment through school garden activities, the project nurtured an early entrepreneurial mindset and reshaped perceptions of agriculture as a viable economic activity. This positions school gardens not only as food production spaces but also as innovation and enterprise development platforms.

Overall, recommendations emphasise the need to move from pilot implementation to institutionalised, community-supported and policy-aligned climate-smart school garden programmes that simultaneously strengthen education, food security and youth entrepreneurship in South Africa. This includes formally introducing the developed posters, infographics, pocket guides and instructional videos for possible adoption by the Department of Basic Education (DoE) and integration into official school enrichment and agricultural education support programmes. This will ensure continuity of use across schools beyond the project sites and strengthen policy-level support for climate-smart school gardening. Provide support for continuous professional development programmes targeted and implemented to strengthen teacher competence in climate-smart agriculture, curriculum integration and school-based enterprise facilitation. With refresher workshops, peer learning platforms and digital training modules based on the developed multimedia resources is recommended to sustain teacher confidence and quality of implementation

Agri-entrepreneurship activities should be further strengthened through structured mentorship programmes, linkages with local markets, agribusinesses and cooperatives. Learners should be exposed to real market environments, basic bookkeeping systems and value-addition opportunities to deepen enterprise learning beyond school-level simulations. With the potential of expanding the developed learning materials to additional

rural and peri-urban schools facing similar water and food security challenges. The provincial education departments, NGOs and development partners could leverage these tools as standardised training and curriculum support resources for climate-smart school garden rollout programmes.

Lastly, have the community and parental involvement, which was observed to have a big contribution to the sustainability of the entire project. The sustainability of school gardens can be further enhanced through stronger involvement of parents and community members in garden management, seedling production, composting and marketing activities. Community participation will reinforce local ownership, skills transfer and broader household food security benefits.

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