Setting Agricultural Research Priorities: The Case for the Agricultural Sector in Swaziland

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Abstract

The present descriptive study determined the research priorities in Swaziland agricultural sector as perceived by agricultural experts in field crops, horticulture and livestock sectors, and used triangulation of desk review, Nominal Group Technique and a modified Delphi technique. Findings revealed that the priorities from national policies are tied-up with the country’s greatest challenge of mitigating the effects of HIV and AIDS on food security, reduction of poverty, and sustainable development. The findings further revealed that forty-three areas in field crops sector needed research. Seven areas in horticulture were considered mostly in need of research. Eleven research areas were considered to be of high priority in the livestock sector. A considerable number of research areas in field crops, horticulture and livestock indicated that the current research system has not adequately addressed research needs, despite the efforts made by the private sector, the University of Swaziland and the Ministry of Agriculture and Cooperatives, for the country to achieve self-sufficiency in food production. From the findings, it was recommended that the research priorities should be used as basis for directing the limited resources in conducting agricultural research. The participation of all stakeholders would facilitate efficient use of resources, to enhance collaboration amongst research institutions. The University of Swaziland should develop research priorities aligned to national polices and objectives to facilitate funding for research by both government and donor agencies.

Key words: Research priorities, agricultural research, agricultural sector.
Introduction

Agricultural research is a powerful tool for addressing the world’s food and poverty challenges. Research produces knowledge and generates technologies for increasing food production (ISNAR, 1998). Agricultural research is an integral part of the process of agricultural development. Edje (1994) pointed out that agricultural research projects in Swaziland were not linked to agricultural development objectives, instead, research programmes were hodgepodge of projects, activities and experiments, resulting in the duplication of efforts and wasting of scarce resources. The challenge to give direction to food security efforts in Swaziland necessitated an investigation of research priorities in agriculture for the immediate and long-term future.

Research priority setting was urgent, given the background of diminishing financial resources. Research priority setting serves as a tool for governments and industries to use in stimulating productive alliances across national innovation system. Research also provides better understanding of markets within the scientific community leading to more informed technology investment decisions. Research acts as a catalyst to public debate, providing valuable learning experiences for policy makers, researchers, industries and the community. Research itself could be used as a strategy to harness funds for research and bridge the needs gap between public sector and industry (Fletcher et al., 1987).

In Swaziland, agricultural research is not systematically organized. Since independence, research had been carried out by private sector, non-governmental organizations (NGOs), Government and the University of Swaziland (Shongwe and Edje, 1994). The literature revealed that national policies and objectives should be aligned with national research agenda (ISNAR, 1987; and Lipton, 1987). Chaparo et al. (1981) described three sources of research priorities. The sources included: socio-economic development policies; technological constraints limiting productivity; and, lastly the prospects of future needs of the country. Elze (1984) also supported the view that research priorities are determined by a country’s socio-economic and political circumstances. The importance of participation of stakeholders in priority setting was emphasized by Geppert et al. (2002); Kelsey &Pense (2001); Franzel et al (1996); and Faris (1991). Pickering (1987) and Hopper (1984) noted that national planners and scientists are significant partners in agricultural planning. Agriculture and agricultural research are facing other challenges. Amongst these challenges are: absence of polices; fragmentation of research institutions (Chalamira,1982); land degradation; scarcity of resources like water and land; decline in soil fertility (FAO,1989); lack of funds and experience in conducting relevant research; diversification of production and shift from subsistence to commercial farming; and overgrazing of livestock (African Development Bank, 2005). Also, Meijerink (2001) and Busch & Lacy (1983) concluded that women are under-represented in science.

The role played by agricultural research is to enhance agricultural growth and development. Prioritizing helps to reduce wasting of financial resources, although research is a long-term investment; and improves the relevance of research. Procedures for setting priorities should be flexible and participatory (Faris, 1997; Hambly &Setswaelo, 1997). Australian Chamber of Commerce and Industry (2002) argued that priority-setting is a tool for governments and industry to stimulate alliances across national innovation systems. Norton &Pardey (1987) discussed several methods of setting priorities. The methods were: weighted criteria model, benefit-cost analysis, mathematical programming and simulation. Kamau et al. (1997) observed that Sub-Saharan African countries do not follow any universal method. Other methods discussed in the literature were: Nominal Group Technique (Mndzebele &Myeni (2002); and Myeni (2000); Borich Method (1980); and, the Delphi Technique (Dalkey &Hemer, 1953;
Purpose and Objectives of the Paper

The purpose of the study was to determine agricultural research priorities in the private and public sectors in Swaziland. The specific objectives were to: determine the relationship between national agricultural development policies and existing agricultural development priorities; and determine the research priorities in the agricultural sector.

Methods and Data Sources

The study used triangulation procedures of desk review, Nominal Group technique (NGT) and a modified Delphi technique. The target population of the study was experts in crops, horticulture, and livestock production sectors which included agricultural employers (N = 32), agricultural officers (N = 15), University of Swaziland agricultural academicians (N = 21); entrepreneurs in agriculture (N = 28), and the Ministry of Agriculture and Cooperative (MOAC) research officers (N = 20). Desk review was conducted to identify research areas as contained in policy documents following content analysis procedures. NGT procedures were followed to obtain research areas considered important by experts. Round one of the Delphi was conducted by requesting participants to list areas in need of research solutions either in field crops, horticulture or livestock production. Desk review data of policy documents and information obtained from the NGT were used to construct a questionnaire and formed round two of the Delphi procedure. The questionnaire consisted of a list of research areas that were to be rated by the experts, in terms of: level of importance, extent of costs, extent of acceptance, extent of constraints and extent of usefulness. Respondents rated by circling the number corresponding to their opinion for each of the domains as follows: (1) Level of importance, 1 = Very unimportant, 2 = Unimportant, 3 = Slightly Unimportant, 4 = Slightly important, 5 = important, 6 = Very important; (2) perceived costs for research area, 1 = Very inexpensive, 2 = Inexpensive, 3 = Slightly inexpensive, 4 = Slightly expensive, 5 = Expensive, 6 = Very expensive; (3) Level of acceptance, 1 = Very unacceptable, 2 = Unacceptable, 3 = Slightly unacceptable, 4 = Slightly acceptable, 5 = Acceptable, 6 = Very acceptable; (4) extent of constraint, 1 = Very great extent, 2 = Great extent, 3 = Moderate extent, 4 = Slight extent, 5 = Very slight extent, 6 = Never; and (5) extent of usefulness, 1 = Very useless, 2 = Useless, 3 = Slightly useless, 4 = Slightly useful, 5 = Useful, 6 = Very useful. A question sorting committee (Q-sort committee) assisted in the validation of the instrument and scrutinized the items derived from desk review, NGT and round one of Delphi. Post-Hoc reliability coefficients were calculated using Cronbach’s alpha coefficient and ranged from .86 to .97. Descriptive statistics were used to analyze data.
Weighted scores were obtained by using the model developed by Borich (1980) and modified by the researchers, and was used to rank research areas. Modification of the Borich model was in the formula used for calculation of need as follows: \( WS = [I + U] - [C_1 + C_2] + A \), where: \( WS \) = weighted score; \( I \) = importance of the research area; \( U \) = usefulness of the research area; \( C_1 \) = costs in producing technology in the research area; \( C_2 \) = constraints associated with the research area; and \( A \) = acceptance of the technology to be produced by the research area. For interpretation purposes, research areas with weighted score 7.50 and above were considered to be of high priority.

**Findings and Conclusions**

Findings regarding objective one: to determine the relationship between national agricultural development policies and existing agricultural development priorities used the desk review method to come up with the results. Five areas of national agricultural development policies were identified: (1) rain-fed crop production; (2) irrigated crop production; (3) livestock production; (4) support services and gender; and (5) food security (Ministry of Agriculture and Cooperatives [MOAC], 2005). Additionally, according to the draft Comprehensive Agricultural Sector Policy (2004), research policies focus on poverty eradication and on creation of more environmentally-sustainable agricultural, fisheries, forestry and food production system. Maize production was considered the highest priority (MOAC, 2005; Dlamini, 2004).

The specific agricultural development priorities are to: increase maize production; improve agricultural market systems and infrastructure to have prices determined by free market forces; emphasize applied agricultural research, focusing on subjects critical to reach sustainable solutions needed to enhance food security; ensure the availability of tested reliable information and suitably-adapted technology, to support and guide livestock development and disease management program through research (MOAC, 2005). However, the MOAC (2005) also stated that the nation’s highest agricultural “development” priority is mitigating the effects of HIV and AIDS on food security. Food security, reduction of poverty and sustainable development, are priority areas in agricultural “development” (MOAC, 2005).

The MA work plans items for agriculture extension services indicate agricultural priorities (MOAC, 2002) as follows: (i) increase maize production; (ii) promote and improve drying and storage of maize grain; (iii) increase planting of legume crops; (iv) promote summer vegetables, baby vegetables and fruit trees; (v) promote root crops demand for sweet potato and cassava; (vi) increase and promote income-generating projects in bee keeping, forestry and cotton; (vii) uplift the nutritional status of families; (viii) promote rehabilitation of degraded land; (ix) improve income generation projects for youth clubs; (x) promote and improve quality of broiler industry; (xi) improve dairy cattle management; (xii) promote production of cash crops; (xiii) facilitate access to credit and donor support; and (xiv) promote production of security/insurance crops.

The agricultural development priority of mitigating the effects of HIV and AIDS on food security is in-line with the stated national agricultural development policies of promoting rain-fed and irrigated crop production, and food security. Even the promotion of livestock production and support services with gender issue as focus are addressing the economic and human relations plight of the hungry and the poor.

Findings regarding objective two: to determine the agricultural research priorities in the agricultural sector, are presented by sector of field crops, horticulture and livestock.
Field crops Sector

Findings under the field crops sector revealed that twenty-five areas needed research, and were of high priority with a weighted score of 7.5 and above (Table 1). The foremost seven areas were: promotion of crop diversity; soil testing for fertilizer application; efficiency of land use; development of drought-resistant varieties; economic uses of organic and inorganic fertilizers; soil testing for lime application; and effects of different application methods of kraal manure.

However, it is worth noting that considering Swaziland is undergoing social crisis due to continuing spread of HIV and AIDS which is exacerbated by high unemployment, income inequality, poverty and food insecurity (ADB, 2005), research on (no. 22) the impact of HIV/AIDS on crop production (weighted score of 7.73) became apparent. One of the strategies to improve food security and broaden family base and new market outlets for the farmers’ produce in the country is crop diversification (ADB, 2005; Edje and Shongwe, 1994; and MOAC (2005). The highest weighted score of 8.86 suggesting research in crop diversification is of no surprise.

Horticulture Sector

In the horticultural sector, thirty-two research areas were identified (Table 2). Seven areas were found mostly in need of research. Hence, the findings, therefore, revealed that in order to conduct important, cost effective, useful and adaptive research, high priority areas were: Promotion of indigenous vegetable production; soil testing for fertilizer requirement; soil testing to determine lime requirement; commercial production of marula trees and marula by-products; promotion of diversified vegetable production; soil sustainability studies for vegetable production; production of baby vegetables; nutritional studies on indigenous vegetables; production of deciduous fruit crops (e.g. peaches, pears); post-harvest research on horticultural produce; production of vegetable seeds; evaluation of vegetable varieties; market research for horticultural produce; hydroponics production in horticulture; organic production of vegetables; organic production of fruits; and, promotion of herb and spice production.

Livestock Sector

Eleven out of thirty-three research areas were found to be of high priority in the livestock sector (Table 3). In order to conduct cost effective, useful and adaptive research, eleven top priorities for the livestock sector were identified. Top priorities were based on weighted scores, which were 7.50 or more. These were: promotion of commercial production of indigenous chickens; promotion of honey production; promotion of and poultry production for export; milk market research; promotion of commercial production of beef; economic viability of livestock production; assessment of water catchments quality in Lowveld; strategies to improve grazing capacity in rural areas; improvement of ranch resources; proper management of beef herd; and determining weaning rates in cattle.

Some research areas were perceived important but might be costly and not easy to adopt. A considerable number of research areas in field crops, horticulture and livestock sectors indicated that the current research system has not adequately addressed research needs despite the efforts made by stakeholders, for the country to achieve food self-sufficiency and food security.
### Table 1

*Weighted Scores of Research Areas in Field Crops Sector by Rank*

<table>
<thead>
<tr>
<th>Research area</th>
<th>WS&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Promotion of crop diversity</td>
<td>8.86</td>
</tr>
<tr>
<td>2. Soil testing for fertilizer application</td>
<td>8.86</td>
</tr>
<tr>
<td>3. Efficiency of land use</td>
<td>8.82</td>
</tr>
<tr>
<td>4. Development of drought-resistant varieties</td>
<td>8.76</td>
</tr>
<tr>
<td>5. Economic uses of organic and inorganic fertilizers</td>
<td>8.63</td>
</tr>
<tr>
<td>6. Soil testing for lime application</td>
<td>8.53</td>
</tr>
<tr>
<td>7. Effects of different application methods of kraal manure</td>
<td>8.51</td>
</tr>
<tr>
<td>8. Economic use of irrigation water</td>
<td>8.49</td>
</tr>
<tr>
<td>9. Development of multi-cob maize varieties</td>
<td>8.42</td>
</tr>
<tr>
<td>10. Agronomic studies on indigenous crops</td>
<td>8.38</td>
</tr>
<tr>
<td>11. Sustainability of seed multiplication of indigenous crops</td>
<td>8.31</td>
</tr>
<tr>
<td>12. Promotion of growth of cassava</td>
<td>8.26</td>
</tr>
<tr>
<td>14. Green manuring in non edible legume plants</td>
<td>8.21</td>
</tr>
<tr>
<td>15. Promotion of multiple cropping</td>
<td>8.21</td>
</tr>
<tr>
<td>16. Timing of lime application</td>
<td>8.08</td>
</tr>
<tr>
<td>17. Development of Striga-tolerant cereal crops</td>
<td>8.07</td>
</tr>
<tr>
<td>18. Biological control of pests, diseases and weeds in field crops</td>
<td>7.97</td>
</tr>
<tr>
<td>19. Maximizing irrigation efficiency in crop production</td>
<td>7.97</td>
</tr>
<tr>
<td>20. Identification of suitable methods of correcting soil acidity</td>
<td>7.82</td>
</tr>
<tr>
<td>21. Promotion of soil erosion control</td>
<td>7.80</td>
</tr>
<tr>
<td>22. Impact of HIV/AIDS on crop production</td>
<td>7.73</td>
</tr>
<tr>
<td>23. Determining the best fertilizers</td>
<td>7.66</td>
</tr>
<tr>
<td>24. Impact of climate change on agricultural production</td>
<td>7.65</td>
</tr>
<tr>
<td>25. Soil sustainability for crop production</td>
<td>7.54</td>
</tr>
<tr>
<td>26. Improvement of sweet potato varieties</td>
<td>7.48</td>
</tr>
<tr>
<td>27. Economic usage of lime in field crops</td>
<td>7.46</td>
</tr>
<tr>
<td>28. Assessment of chemical residues in water sources</td>
<td>7.34</td>
</tr>
<tr>
<td>29. Development of varieties suitable for acid soils</td>
<td>7.33</td>
</tr>
</tbody>
</table>

*Note.* WS<sup>1</sup> = Weighted score; obtained using a Modification of the Borich’s Model formula as follows: \[ WS = \left[ I + U \right] - \left[ C_1 + C_2 \right] + A, \] Where: WS = Weighted score; I = importance of the research area; U = usefulness of the research area; C<sub>1</sub> = costs in producing technology in the research area; C<sub>2</sub> = constraints associated with the research area; and A = acceptance of the technology to be produced by the research area.

### Table 2

*Weighted Scores of Research Areas in Horticulture Sector by Rank*

<table>
<thead>
<tr>
<th>Research area</th>
<th>WS&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Promotion of indigenous vegetable production</td>
<td>9.33</td>
</tr>
<tr>
<td>2. Soil testing for fertilizer requirement</td>
<td>9.01</td>
</tr>
<tr>
<td>3. Soil testing to determine lime requirement</td>
<td>8.92</td>
</tr>
<tr>
<td>4. Commercial production of marula trees and marula by-products</td>
<td>8.54</td>
</tr>
<tr>
<td>5. Promotion of diversified vegetable production</td>
<td>8.50</td>
</tr>
<tr>
<td>6. Soil sustainability studies for vegetable production</td>
<td>8.45</td>
</tr>
</tbody>
</table>
7. Production of baby vegetables 8.43
8. Nutritional studies on indigenous vegetables 8.33
9. Production of deciduous fruit crops (e.g. peaches, pears) 8.10
10. Post harvest research on horticultural produce 8.06
11. Production of vegetable seeds 7.98
12. Evaluation of vegetable varieties 7.95
13. Market research for horticultural produce 7.87
14. Hydroponics production in horticulture 7.75
15. Organic production of vegetables 7.72
16. Organic production of fruits 7.71
17. Promotion of herb and spice production 7.55
18. Water pollution by chemical residues 7.29
19. Processing of a wider variety of fruits 7.29
20. Seedling production in foil trays 7.26
21. Promotion of commercial production of grapes 7.16
22. Biological control of pests, diseases and weeds 7.13
23. Breeding of horticultural crops 7.00
24. Evaluation of chemicals for plant protection 6.95
25. Processing of vegetables 6.78
26. Frost protection in vegetable production 6.23
27. Production of more banana varieties 6.17
28. Breeding of horticultural crops 7.00
29. Evaluation of chemicals for plant protection 6.95
30. Processing of vegetables 6.78
31. Frost protection in vegetable production 6.23
32. Production of more banana varieties 6.17
33. Chemical control of pests, weeds and diseases 6.07
34. Promotion of biotechnology in horticulture 5.95
35. Promotion of blue berries 5.87
36. Promotions of flower production 5.69
37. Improvement of planting material in pineapples 5.41

Note. WS\textsuperscript{1} = Weighted score; obtained using a Modification of the Borich’s Model formula as follows: WS = [I + U] – [C\textsubscript{1} + C\textsubscript{2}] + A, Where: WS = Weighted score; I = importance of the research area; U = usefulness of the research area; C\textsubscript{1} = costs in producing technology in the research area; C\textsubscript{2} = constraints associated with the research area; and A = acceptance of the technology to be produced by the research area.

Table 3: Weighted Scores of Research Areas in Livestock Sector by Rank

<table>
<thead>
<tr>
<th>Research area</th>
<th>WS\textsuperscript{1}</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Promotion of commercial production of indigenous chickens</td>
<td>8.64</td>
</tr>
<tr>
<td>2. Promotion of honey production</td>
<td>8.35</td>
</tr>
<tr>
<td>3. Promotion of and poultry production for export</td>
<td>8.34</td>
</tr>
<tr>
<td>4. Milk market research</td>
<td>8.30</td>
</tr>
<tr>
<td>5. Promotion of commercial production of beef</td>
<td>8.11</td>
</tr>
<tr>
<td>6. Economic viability of livestock production</td>
<td>8.03</td>
</tr>
<tr>
<td>7. Assessment of water catchments quality in Lowveld</td>
<td>7.82</td>
</tr>
<tr>
<td>8. Strategies to improve grazing capacity in rural areas</td>
<td>7.78</td>
</tr>
</tbody>
</table>
9. Improvement of ranch resources 7.58
10. Proper management of beef herd 7.56
11. Determining weaning rates in cattle 7.54
12. Diversification of livestock production 7.43
13. Use of agro industrial by products as feed for livestock 7.42
14. Adaptability of cattle breeds to different regions 7.37
15. Sustainability of supplementary feeding of veld-reared beef 7.33
16. Manufacture of feed 7.30
17. Breeding of dairy cows 7.30
18. Promotion of fish production 7.16
19. Farm yard manure management 7.13
20. Combat desertification and land degradation 7.09
21. Evaluation of tick and tick borne diseases 6.99
22. Pure breeding of livestock 6.94
23. Prevention and control of poultry diseases 6.86
24. Commercial production of small ruminants 6.72
25. Reduction of invasive species 6.70
26. Development of feedlots 6.61
27. Rabbit production 6.56
28. Production of beef in feedlots 6.49
29. Development of slaughter facilities 6.31
30. Promotion of commercial production of guinea fowl 6.24
31. Economic viability of game ranching 6.17
32. Breeding of milk producing goats 5.22
33. Breeding of horses 1.48

Note. WS = Weighted score; obtained using a Modification of the Borich’s Model formula as follows: WS = [I + U] - [C1 + C2] + A, Where: WS = Weighted score; I = importance of the research area; U = usefulness of the research area; C1 = costs in producing technology in the research area; C2 = constraints associated with the research area; and A = acceptance of the technology to be produced by the research area.

On the bases of the present findings, the conclusions that can be drawn are that the research priorities obtained were derived from Swazi people’s needs. The direct implications are that, even with the implementation process, the stakeholders should be involved to enhance collaboration and conduct timely research. The research priorities were derived from ratings by the respondents on the level of importance, usefulness, and costs associated with conducting that particular research, extent of constraints in conducting research and the level of acceptance. The findings showed that a considerable number of research priorities in both field crops and horticulture, are that the current research system has not adequately addressed research needs. The vast demand of research is on: soil fertility improvement; indigenous and organic production of crops, vegetables and fruits; the need for crop diversification; efficiency of agricultural resources such as land and water; promotion of commercial production of crops and vegetables; pest, weeds and diseases control; local production of seeds; and, market research to mention a few. Despite the efforts made by the private sector, the University and MOAC, for the country to achieve self sufficiency in food production, the research priorities imply that more need to be done to address the issues food security; poverty alleviation, mitigation the effects of HIV and AIDS, adapting to changing climate and to improve the economy of the country through increased exports. The findings also indicated that considerable research need to be carried out in
the livestock sector, especially indigenous poultry production; beef management and commercialization, honey production, management of resources like water and grazing land; and milk market research. This further implies that there is need for farmers to shift from subsistence to commercial production of cattle and poultry. Again, low input projects and the global trend of consumers’ demand that are towards changing to healthy lifestyle seem to influence agricultural production. This is shown by the demand of research on indigenous and organic agricultural products, and products of high nutrition and medicinal value like baby cabbages, herbs and spices, and honey.

Swaziland is still developing its agricultural policies, yet a need to develop technologies that will address social, cultural and economic issues in the country is apparent. Technologies should be based on the national policies and objectives. Moreover, the challenges of HIV and AIDS, recurrent drought and poverty, need urgent attention. Agricultural research is one way of addressing the problems. With these considerations and conclusions drawn from the study, the implication is to develop technologies that will alleviate poverty, improve food security and nutrition, and create employment whilst conserving the natural resources and reduction of costs of production. Evidence is shown by the need to diversify crop production, commercialization of livestock and crop production, improvement of soil fertility, efficient land use, improve marketing, production of indigenous crops and vegetables, use of organic methods of farming and properly managing livestock.

Research priority setting in this study, involved experts in crops, horticulture, and livestock production sectors that included private sector agricultural employers, NGO’s agricultural officers, University of Swaziland agricultural academicians, entrepreneurs in agriculture, and the Ministry of Agriculture and Cooperative (MOAC) research officers. The inclusion of stakeholders for agricultural research in the study was an attempt to bring together scientists and policy makers to make joined and informed efforts about research priorities identification, and to provide clear choices to guide the allocation of limited resources and to avoid duplication. This approach should also assist in linking and integrating research and policy.

Educational Importance

The study forms as base for the national research system to confirm the identified agricultural research needs of the country. Furthermore, findings from this study would assist the research system keep pace with agricultural knowledge and technology demands of the Swazi society. The expected impact of setting agricultural research priorities is that a well-articulated agenda for agricultural research in Swaziland would be developed, and efforts in conducting agricultural research would be linked to agricultural development objectives. Duplication of efforts and waste of scarce resources would be avoided. Funding by government, donors and/or other sources for agricultural research could be targeted to areas regarded as high priority. Research units will have some reference on which to base their research programmes and activities.
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