References


Gatongi, P.M., 1995. Seasonal variation of egg count to total worm count index in small ruminants. *Proceedings of the Scientific Conference held at the National Veterinary Research Center, Muguga, Kenya, 6-8 December, 1995.*


# Annexure 1

**QUESTIONNAIRE SURVEY ON WORM CONTROL IN SMALL RUMINANTS**

**Section I. To be answered by the Animal Health Workers (AHW)**

```
Name ..................................................................................................................................

Zone ....................................................................................................................................

Address .................................................................................................................................
```

To answer questions, please tick or choose number and write in the space provided.

**Q I. Do you treat sheep and goats to control worms?**

**Q II. During which seasons do sheep and goats in your area need anthelmintics treatment most?**

1. Between June and September
2. Between October and December
3. Between January and May

**Q III. Please specify if you drench at the following occasions**

1. Drench when farmers request?
2. Drench in connection to mortality sheep & goats?
3. Drench after faecal examination for worms?
4. Drench as seasons change
Q. IV. How do you get your anthelmintic supply?

1. From Zonal bureau of agriculture
   - Yes
   - No

2. Regional state bureau of agriculture
   - Yes
   - No

3. Any local drug store/pharmacy
   - Yes
   - No

Q V. Rank from 1 to 5 the criteria most commonly used (1) to the least commonly used (5) by farmers when selecting anthelmintics.

1. Price of drugs
2. The drug is of bolus & easy to take
3. Known by colour & trusted efficacy
4. Experience of good effect
5. Recommendation from veterinarians

Q VI. Do farmers in your area buy anthelmintics so that they can treat sheep and goats on their own?

Yes
No

Q VII. Do you think farmers knowingly or unknowingly under-drench the recommended dosage?

1. Yes, they could without knowing
2. No they do not
3. Do not know

Q VIII. Do you change the class of anthelmintics you use each year?

Yes
No

Q IX. Do you change the class more than once per year?

Yes
No

Q X. Have you had flocks tested for anthelmintic resistant nematode in your area?

Yes
No

Q XI. Have you had any problems with any anthelmintic?

Yes
No
Q XII. Please tick the anthelmintics you used during the last four years (tick for every year).

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<thead>
<tr>
<th></th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
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<tr>
<td>ALBENDAZOLE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Fenbendazole</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Wormita</td>
<td></td>
<td></td>
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<tr>
<td>3. Wormex</td>
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</tr>
<tr>
<td>4 Oxibendazole</td>
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<td>9 Albenol</td>
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<td>10 Febantel</td>
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<tr>
<td>11 Deaxamine</td>
<td></td>
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<td>12 Pamizole sheep</td>
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<tr>
<td>13 Tetramisole</td>
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<td>14 Bolumisol</td>
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<td></td>
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<td></td>
</tr>
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<td>15 Fenbendazole</td>
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<td>AVERMECTINS</td>
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<tr>
<td>16 Ivermectin</td>
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<td>17 Doramectin</td>
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<tr>
<td>18 Avimec</td>
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<tr>
<td>19 Ivecin</td>
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<td></td>
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<td>SALICYLANILIDES</td>
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<tr>
<td>20 Closantel</td>
<td></td>
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<tr>
<td>21 Rafoxanide</td>
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</tr>
<tr>
<td>If others write &amp; tick</td>
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</tr>
</tbody>
</table>

Q XIII Do you know of any farmer in your area who uses herbal preparation for the control of worms in animals?

Yes  No
Q XIV. Animals may be treated according to their live-weight. How do you estimate the weight of sheep or goat?
Sheep
1. Visual estimate
2. After weighing

Goats
1. Visual estimate
2. After weighing

Q XV. Which body weight of sheep or goats do you use for estimating dose for drenching (please tick once at sheep and sheep)?
Sheep
1. Weight of lightest animal
2. Average body weight
3. Weight of heaviest animal
4. Weight of individual animal

Goat
1. Weight of lightest animal
2. Average body weight
3. Weight of heaviest animal
4. Weight of individual animal

Q XVI. Do you agree to participate in similar study in the future?

Thank you for your cooperation
Annexure 2

QUESTIONNAIRE SURVEY ON WORM CONTROL IN SMALL RUMINANTS

Section II. To be answered by farmers (or his/her representative).

Farmer's name ........................................................................................................
Zone ......................................................................................................................
District ..................................................................................................................
Peasant farmers’ association (PA) ...........................................................................

A. Questions on farm data

Q I. Is the respondent the farm owner or employee?
   1. Farm owner
   2. Employee
   3. Relative

Q II. Gender
   1. Female
   2. Male

Q III. What is the level of your education?
   1. Primary
   2. Secondary
   3. Read & write
   4. Illiterate
Q IV. How many sheep do you have?
1. Lambs
2. Adult
3. None

Q V. How many goats do you have?
1. Kids
2. Adult
3. None

Q VI. Where do your sheep and goats graze?
1. Back yard
2. Communal grazing
3. Anywhere the animals get grass

Q VII. Do your sheep graze together with?
1. Cattle
2. Horse and donkeys
3. Goats

Q VIII. What is the condition of the communal grazing area?
1. Poor
2. Average
3. Very good
Q IX. How far is the communal grazing area from your house?
   1. About Km
   2. Between and 2 Km
   3. About 3 Km
   4. About 5 Km or more

Q X. Do you supply feed to your sheep and goats?

Q XI. What type of supplement?
   1. Hay
   2. Forage leaves
   3. Concentrates

Q XII. Which health problems have you encountered with your sheep and goats?
   1. Infectious diseases
   2. Parasitic diseases (worms)
   3. If other specify

Q XIII. When do you think the animals’ health deteriorates?

Q XIV. Did you have sick animals last season?

Q XV. Did your sheep and goats die?

Q XVI. Which worms cause problems?
   1. Flukes
   2. Round worms
   3. All worms
B. Questions on worm control

Q XVII. Do you treat sheep and goats for worm control?  

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

Q XVIII. Who takes care of your animal health?  

- 1. Self  
- 2. Veterinarians from the Ministry of Agriculture  
- 3. Private veterinary practitioners  
- 4. Traditional healers

Q XIII. When do you think the animals’ health deteriorates?  

<table>
<thead>
<tr>
<th>Always (1)</th>
<th>Sometimes (2)</th>
<th>Never (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q XIX. How many times do you treat you sheep and goats with anthelmintics?  

<table>
<thead>
<tr>
<th>Commonly (1)</th>
<th>Sometimes (2)</th>
<th>Never (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q XX. Do you know how to dose animals with anthelmintics?  

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>
Q XXI. How do you recognize worm problems in your sheep and goats?
   1. Diarrhoea and/or coughing
   2. Emaciation
   3. General weakness/illness sign
   4. Bottle jaw

Q XIV. Do you observe diarrhoea, loss of body condition or other signs in ewes or dams around the time of parturition?

Q XXIII. If you deworm your animals yourself, from where do you obtain the drugs?
   1. Open market
   2. From drug vendors
   3. From other farmers

Q XXIV. How important are the following criteria to select the anthelmintics?
   1. Colour of the drug
   2. History of the drug efficacy
   3. Recommendation by other farmers
   4. Recommendation by veterinarians

Q XXV Have you had any problems with any anthelmintics?

Q XXVI. Have you noticed any drug which was not effective?

Q XXVII. Do you know people in your area who use herbs to control worms in animals?
Q XXVIII. How important are the following sources for you to gain knowledge about worms and their management?

1. Farmers’ Associations
2. Radio, TV and Newspapers
3. Extension program of the MOA
5. Private vet. Clinics
6. Rural vet. drug vendors
7. Traditional healers

<table>
<thead>
<tr>
<th></th>
<th>Very important (1)</th>
<th>Important (2)</th>
<th>Not important (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Q XXIX. Was there any governmental or non-governmental program design for worm control strategy in your locality?

Yes | No

Q XXX. Do you agree to participate in a project to study the management of worm control in sheep and goats in your area?

Yes | No

Thank you for your cooperation
### Table A1. Manova Test criteria and exact F statistics for the hypothesis of no weight effect in sheep in the FAMAQCHA© trial.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
<th>F value</th>
<th>DF</th>
<th>Den DF</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilks’ Lambda</td>
<td>0.0531</td>
<td>25.43</td>
<td>14</td>
<td>20</td>
<td>0.0001</td>
</tr>
<tr>
<td>Roy’s Greater Root</td>
<td>17.801</td>
<td>25.43</td>
<td>14</td>
<td>20</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the "H0" hypothesis that there is no weight effect (P<0.0001).

### Table A2. Manova Test criteria and exact F statistics for the hypothesis of no weight effect and group interaction in sheep in the FAMAQCHA© trial.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
<th>F value</th>
<th>DF</th>
<th>Den DF</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilks’ Lambda</td>
<td>0.028</td>
<td>3.37</td>
<td>42</td>
<td>60.095</td>
<td>&lt;0.0001</td>
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<tr>
<td>Roy’s Greater Root</td>
<td>5.082</td>
<td>7.99</td>
<td>14</td>
<td>22</td>
<td>&lt; 0.0001</td>
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</tbody>
</table>

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the "H0" hypothesis that there is no weight*group effect (P<0.0001).

### Table A3. Manova Test criteria and exact F statistics for the hypothesis of no weight effect in goats in the FAMAQCHA© trial.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
<th>F value</th>
<th>DF</th>
<th>Den DF</th>
<th>Pr&gt;F</th>
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</thead>
<tbody>
<tr>
<td>Wilks’ Lambda</td>
<td>0.094</td>
<td>17.89</td>
<td>14</td>
<td>26</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Roy’s Greater Root</td>
<td>9.634</td>
<td>17.89</td>
<td>14</td>
<td>26</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the "H0" hypothesis that there is no weight effect (P<0.05).

### Table A4. Manova Test criteria and exact F statistics for the hypothesis of no weight effect and group interaction in goats in the FAMAQCHA© trial.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
<th>F value</th>
<th>DF</th>
<th>Den DF</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilks’ Lambda</td>
<td>0.161</td>
<td>1.58</td>
<td>42</td>
<td>77.894</td>
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<tr>
<td>Roy’s Greater Root</td>
<td>9.634</td>
<td>3.75</td>
<td>14</td>
<td>26</td>
<td>&lt; 0.001</td>
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</tbody>
</table>

The dependent variables are the levels of monthly weight gain or loss (w1-w15)
Reject the “H0” hypothesis that there is no weight*group effect (P<0.05).
**Annexure 4**

Sensitivity, specificity and predictive values for positive and negative tests of sheep using FAMACHA® scores and haematocrit cut-off for positive test results and anaemia

<table>
<thead>
<tr>
<th>FAMACHA® categories</th>
<th>Ht&lt;19% n</th>
<th>Ht&gt;19% n</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PV* (-ve)</th>
<th>PV# (+ve)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,4,5</td>
<td>30</td>
<td>74</td>
<td>90.9</td>
<td>86.6</td>
<td>99.3</td>
<td>28.9</td>
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<tr>
<td>1,2</td>
<td>3</td>
<td>476</td>
<td>72.7</td>
<td>92.2</td>
<td>98.3</td>
<td>35.3</td>
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<tr>
<td>Total</td>
<td>33</td>
<td>550</td>
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<td></td>
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<td></td>
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<tr>
<td>4,5</td>
<td>24</td>
<td>44</td>
<td></td>
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<tr>
<td>1,2,3</td>
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<td>522</td>
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<td>Total</td>
<td>33</td>
<td>550</td>
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</tbody>
</table>

n=number of observations,  Ht<19% anaemia present, Ht>19% anaemia absent, *Predictive value positive, #Predictive value negative.

When FAMACHA® values equal 4 and 5, the Chi-square = 136.1037, P <0.0001
Fishers Exact Test: 2-sided P <3.579E-26, Thus, P <0.001

When FAMACHA® values equal 3, 4 and 5, the Chi-square = 197.6721 P <0.000
Fishers Exact Test: 2-sided P <5.078E-7, Thus, P <0.0001.

Sensitivity, specificity and predictive values for positive and negative tests of goats using FAMACHA® scores and haematocrit cut-off for positive test results and anaemia

<table>
<thead>
<tr>
<th>FAMACHA® categories</th>
<th>Ht&lt;19% n</th>
<th>Ht&gt;19% n</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PV* (-ve)</th>
<th>PV# (+ve)</th>
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<tbody>
<tr>
<td>3,4,5</td>
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<td>Total</td>
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<tr>
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<td>1,2,3</td>
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<tr>
<td>Total</td>
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<td>628</td>
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</tr>
</tbody>
</table>

n=number of observations,  Ht<19% anaemia present, Ht>19% anaemia absent, *Predictive value positive, #Predictive value negative.

When FAMACHA® values equal 4 and 5, the Chi-square = 175.31105, P <0.001,
Fishers Exact Test: 2-sided P <3.579E-26, Thus, P <0.001

When the FAMACHA® values equal 3, 4 and 5 the Chi-square = 127, 4296, P <0.0001
Fishers Exact Test: 2-sided P <3.579E-26, Thus, P <0.001.
Annexure 5

INSTRUCTIONS FOR USE
Examination
- Examine sheep in good, natural light
- Open the eyelid as shown in the sketch
- Push the upper eyelid down with the upper thumb, while the lower thumb gently pulls the lower lid downward
- Look especially at the colour inside the lower eyelid
- Open the eyelid for a short time only, or else the mucus membrane may become redder
- Compare the colours seen those on the reverse side of this card
- Score the sheep 1 to 5 and proceed as explained in the pamphlet
- If in doubt, score the sheep at the lower (paler) category
- Examine weekly and no less than every 2 to 3 weeks
- Contact your veterinarian if you have any questions

Precautions
- Only properly trained persons should use this card
- Read the full information pamphlet before using the guide and follow instructions carefully
- This guide is intended for sheep only
- If used for goats, all those in category 3 should also be treated
- This card is an aid in the control of wireworm only
- Paleness or reddening of the eyes may have other causes
- Maintain standard worm control measures
- The colours of this card will fade with time, especially if exposed to the sun
- Replace the card after 12 months use
- As the system is used in conditions outside their control, no organization involved in its development or distribution accepts liability for losses or problems associated with its use

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email: gfbath@op.up.ac.za