REGIONAL WORKSHOP ON BRUCELLOSIS CONTROL
IN CENTRAL ASIA and EASTERN EUROPE

09 – 11 April 2013

International Agricultural Research and Training Center (UTAEM)

Izmir, Turkey

Food and Agriculture Organization Sub-regional Office for Central Asia,
Ankara, Turkey
Table of Contents

Introduction.................................................................................................................................3
Objectives of the Workshop........................................................................................................3
Brucellosis Disease Control Strategies & Trends in the Region .............................................3
  Discussion of disease control strategies ..............................................................................5
Draft Roadmap for Progressive Control of Brucellosis in Livestock .................................8
Conclusions & Recommendations from the Workshop .....................................................9
  Conclusions .........................................................................................................................10
  Recommendations to FAO ..................................................................................................10
  Recommendations to OIE .................................................................................................11
  Recommendations to authorities in the participants’ countries .................................11
  Table 1. Strategies for brucellosis control in sheep and goats in countries in
         the regions (2013) ...........................................................................................................13
  Table 2. Strategies for brucellosis control in large ruminants in countries in
         the regions (2013) ...........................................................................................................14
  Table 3. Trends in brucellosis disease rates in small and large ruminants and
         in humans in countries in the regions (2013) ..........................................................17
Introduction

The Food and Agriculture Organization (FAO) Regional Office for Eastern Europe and the Sub-regional Office for Central Asia, in close coordination with AGAH organized a regional workshop on brucellosis control in central Asia and Eastern Europe. The workshop took place in in Izmir, Turkey, from 9 to 11 April 2013.

Two representatives from each of 10 countries participated in the workshop, namely the Republic of Albania (ALB), Republic of Azerbaijan (AZE), Bosnia and Herzegovina (BIH), Georgia (GEO), Republic of Kazakhstan (KAZ), Kyrgyz Republic (KYR), The Former Yugoslav Republic of Macedonia (MKD), Republic of Tajikistan (TAJ), Republic of Turkey (TUR) and Republic of Uzbekistan (UZB). Representatives were invited from international organizations, including the World Organisation for Animal Health, World Bank, European Community and the World Health Organization. The World Health Organization (WHO) was represented by Ms. Hilde Kruse, Copenhagen, Denmark. Mr. Joseph Domenech, Paris, France, represented the World Organisation for Animal Health (OIE). Ms. Wendy Beauvais, London Veterinary College, presented statistical modeling and survey results from brucellosis in Egypt. Messrs. Abdul Baqi Mehraban and Andriy Rozstalnyy, from the Sub-regional Office for Central Asia and the Regional Office for Eastern Europe, organized and chaired discussion sessions. Mr. Ahmed El-Idrissi, FAO Headquarters, Rome, was instrumental in organizing the workshop but could not attend due to illness.

Mr. Nahit Yazicioglu, Head of Animal Health, Ministry of Food, Agriculture and Livestock, opened the workshop on behalf of the Government of Turkey and chaired the first session.

Objectives of the Workshop

The workshop is organized in support of FAO efforts to assist countries in Central Asia and Eastern Europe to develop and implement sound strategies and policies for sustainable brucellosis control programmes. Topics addressed in the workshop include:

1. An overview of the epidemiological situation of brucellosis and control programmes in each participating country.
2. Discussion of brucellosis control strategies in Central Asia and Eastern Europe.
3. Presentation and discussion of the strategic framework for progressive control of brucellosis as a guide for developing sustainable national control programmes.
4. Identify key elements among countries in the regions for developing effective national strategies for progressive control of brucellosis.
5. Identify issues and opportunities for enhancing regional collaboration among countries to progressively control brucellosis in livestock.

Brucellosis Disease Control Strategies & Trends in the Region

Countries in the two regions are facing some of the highest human brucellosis rates of any countries in the world (Pappas, et al, Lancet Infect Dis. 2006: 6(2): 91-99) (Figure. 1). Seven republics of the former Soviet Union are now among the 25 countries with the highest incidence of brucellosis in humans. Brucellosis is endemic in all Central Asian and Eastern European countries and national authorities in these countries have been struggling against the disease for many years.
In the Eastern European countries, rates in humans range in the double digits per million population -- 21 to 64, except in The Former Yugoslav Republic of Macedonia where 148 cases per million are reported. In Central Asian countries, the rates are generally 10 times higher, i.e. in the triple digits. Reported cases in humans range between 116 in Kazakhstan to 362 in Kyrgyzstan. Of the Central Asian countries only Uzbekistan reports double digit rates of 18 cases per million human population. These rates compare with 4.1 cases in Russia, 21 cases in Greece, 0.3 cases in Germany and the United Kingdom and 0.09 in Canada, all per million population. Public health officials also acknowledged that brucellosis incidence in humans is severely underdiagnosed. Clearly, in the mid-2000s brucellosis was not an insignificant human disease in Central Asian and Eastern European countries. It is heartening to know that seven of the 10 participating countries reported that the number of human cases is falling in the last several years.

The economic cost of brucellosis in humans and livestock is not well studied for individual countries. In Kyrgyzstan the economic cost was recently estimated at between USD 5 – 15 million annually with current rates of infection (Jakob Zinsstag, et al., Swiss Tropical Institute, unpublished). In a World Bank study (unpublished, 2011) the total benefit from investing in brucellosis control was estimated at net present value US dollars 44.6 million in Kazakhstan, 55.1 million in the Kyrgyz Republic, 17.3 million in Tajikistan and 18.3 million in Uzbekistan.

Information in Tables 1-3 was reported during workshop presentations and discussions of the brucellosis sanitary situation and trends over the past decades. Additionally, findings were updated from similar data and information reported in 2009 by some of the countries who participated in a similar workshop in Dushanbe (Workshop on Developing a Brucellosis Control Strategy in Central Asia, 14 – 16 October 2009, Dushanbe, Tajikistan, FAO, Rome, pp 26).

Veterinary and human health authorities in participating countries are today struggling to reduce brucellosis disease rates in livestock and humans. The veterinary services in seven countries, except those of Georgia, Kazakhstan and Uzbekistan, are using the internationally recommended strategy of whole flock vaccination with ocular Rev 1 vaccine in sheep and goats for the initial one or two years then vaccinating replacement stock in subsequent years. Five of 7 countries using this strategy have significantly reduced brucellosis disease in small ruminants. Changes are too soon to measure in the other three countries using this strategy. Kazak veterinary authorities intend to conduct in 2013 research by testing various Brucella vaccines on several individual farms in a pilot study lasting several years. Uzbek authorities continue to undertake ring vaccination and test and slaughter strategy in infected districts. Georgian authorities have yet to adopt a control strategy.

Five of 10 countries intermittently use vaccines (S19, S82 or RB51) for controlling bovine brucellosis. The remaining five countries implement bovine brucellosis control strategies which range from test and slaughter alone or test and slaughter plus vaccination nation-wide, vaccination only in outbreak districts or only on remaining state farms. In 2013 Turkey uses both adult and calfhood (Strain 19 ocular) vaccination and test and slaughter. In any case, most countries report not having bovine brucellosis under satisfactory control and veterinary authorities are re-thinking strategies for controlling or eradicating this disease in large ruminants.
Interestingly, bovine brucellosis was reduced in two (BIH, KRY) and possibly a third country (TAJ) where ocular Rev 1 vaccine significantly reduced prevalence of brucellosis in small ruminants. These countries are urged to investigate this trend and gather data to further document changes in bovine brucellosis prevalence.

Participants recognize that husbandry systems, status of national veterinary services, funding and political will are all different in the regions. However, the evidence that ocular Rev 1 vaccination strategies are effectively controlling the disease in small ruminants under these varying conditions is most gratifying. This success in reducing small ruminant brucellosis reconfirms that quality assured Rev 1 vaccine and modern vaccination strategies can be applied effectively by national veterinary services in these countries. The participants elaborated on specific gaps in understanding of brucellosis control in their countries and no doubt gained from the experiences of others.

It is heartening for country representatives and for FAO to know that Governments are being assisted by international donors and/or development institutions, like the World Bank, European Union and FAO, or bi-lateral assistance in actively supporting national brucellosis control programmes in 8 of the 10 countries represented. The transversal role of the OIE through the adoption of permanently updated specific standards on brucellosis and other horizontal appropriate chapters of the Terrestrial Code and of the Terrestrial Manual, through the reporting and dissemination of disease events (World Animal Health Information System (WAHIS) and through the strengthening of veterinary services (use of PVS Pathway tools) was recognized by all participants and should be continued in support of brucellosis control strategies as any other major transboundary animal diseases.

It is reassuring too that internationally recommended control strategies in small ruminants based on ocular Rev 1 vaccination are effective and are enthusiastically supported by stakeholders in countries where these strategies and vaccine are being used. Epidemiologically-based management methods are recognized as essential to monitor vaccination campaign delivery plus periodic serological surveys are carried out or planned for monitoring changes in brucellosis prevalence over several years. There is more work to be done particularly in implementing cost-effective control or eradication strategies against brucellosis in large ruminants. But experience over the last 60 years in many countries should be useful for adoption and application in countries in the two regions.

**Discussion of disease control strategies**

The participants recognized that brucellosis was endemic in countries in the two regions. They agreed that regional collaboration in controlling brucellosis and other transboundary animal diseases (TADs) and zoonoses could leverage national efforts and enhance effectiveness in the regions. Regular and formal collaborations for discussing mutual problems, information sharing, harmonizing strategies, control methods and diagnostic protocols, and monitoring disease control progress were all considered essential for effectively controlling brucellosis and TADs in the regions.

Most countries in Eastern Europe and several in Central Asia are making good progress in reducing brucellosis prevalence in small ruminants. In order to protect their investments, their neighbours need to enhance control measures within their own borders. If neighbouring countries fail to reduce brucellosis rates in small ruminant livestock, there is a high risk of reinfection and progress being made in some countries will be slowed.
The seasonal movement of livestock within countries and across borders is considered by all countries as a major risk for spreading brucellosis (and other TADs). Thus, uncontrolled animal movements may compromise control progress in vaccinated areas and could be a threat to the five countries where significant reduction of brucellosis has been achieved and measured over the last several years.

The role of animal meats as a risk factor for brucellosis transmission has again been clarified. There are no reports in the literature that brucellosis can be transmitted from livestock muscle meats to humans (Robinson, A, Brucella melitensis in Eurasia and the Middle East, FAO technical meeting in collaboration with WHO and OIE, 11-14 May 2009 Rome, FAO Animal Health Proceedings 2010, pp 13 – 14).

As a first step in controlling brucellosis in sheep and goats, participating countries had good results with whole flock vaccination of all non-pregnant females (adult and immature) in the initial one or two years, then vaccinating only replacement stock for 4 – 6 subsequent years.

Strategies for controlling brucellosis in large ruminants are much less effective. Serological testing with slaughter of test-positive animals is not always cost-effective in controlling or eradicating brucellosis in large ruminants. The reasons for lack of progress in each country need careful review and analysis. But experience shows that test and slaughter strategies are not effective unless and until:
- movement controls are effective,
- animals are individually identified with a permanent number,
- adequate compensation is paid promptly,
- livestock owners support the control strategy and cooperate with veterinary authorities,
- veterinary and public health physicians cooperate in control,
- effective legislation is enacted, and
- a long-term strategy is supported by stakeholders.

These and other key externalities are well described in the FAO Roadmap for control of brucellosis in livestock presented in this workshop.

Participants recognized that currently countries do not have in place satisfactory or effective animal movement controls. Uncontrolled movements, including sales in livestock markets, of brucellosis infected livestock are a well-recognized risk for spreading the disease. And this risk was documented in some countries. Having more effective systems for recording and controlling livestock movement is an essential requirement for progressing from a vaccination strategy to an effective test and slaughter strategy. Effective movement controls and individual animal identification are essential for cost-effective eradication of brucellosis by test and slaughter.

No countries represented in the workshop undertake test and removal of serotest positive animals prior to vaccination with Rev1 (or other) vaccine. No undesirable effects are detected when using currently produced, quality assured Rev 1 vaccines without prior test and removal of serotest positive animals. Thus the cost of pre-vaccination serological testing is avoided as being unnecessary.
Experience in the regions and globally is that no harm comes from vaccinating *Brucella*-infected livestock using Rev 1 vaccines. No ‘cure’ is expected from this practice but no harm occurs either. There is a Rev 1 vaccine label instruction to ‘vaccinate only healthy animals’. This is a recognized generally good veterinary medical practice. However it is also recognized that commonly used serological tests for brucellosis, particularly the Rose Bengal and ELISA tests, are less than 100 per cent sensitive nor 100 per cent specific. Thus, not all *Brucella*-infected animals are detected during any one serotesting round. Therefore, even if detected test-positive reactors are removed, some truly infected animals are still missed by serotests and are subsequently vaccinated – with no harm detected and many hundreds of thousands of animals vaccinated each year.

Additionally immature animals in the early stage of infection will not produce antibodies and cannot be detected by serotests. ‘Latent infection’ is also recognized in large and small ruminants, where 5 – 10 per cent of fetuses are infected *in utero* from their *Brucella*-infected dams. Infection in these animals cannot be detected by standard tests until they mature and females give birth themselves.

Any one round of screening tests with RBT (or any other test) cannot detect all *Brucella*-infected animals. A few *Brucella*-infected animals will remain in the herd or flock in the early years of control programmes. And global experience finds that testing and removal of infected animals before vaccination is not necessary.

Technical limitations of all currently available tests, plus limited funding, make brucellosis control and eradication a long road, lasting well over 20 years in the best of circumstances in most countries. The many years of work and expense requires strong leadership from veterinary and public health authorities in order to maintain national political will to keep up the long struggle against this disease.

The workshop organizers are heartened to know that open debate among most of the participating countries is based on recent and successful experience in controlling brucellosis in small ruminants. The former strategies and practices of 30 years ago are being challenged and phased out based on recent practical field experience from their own countries. Along with their own experiences and learning lessons from neighbours, a modern understanding of the principles for effective brucellosis control for small ruminants is well advanced. The complexity of brucellosis control in large ruminants is being recognized too and strategies are or will shortly be applied based on epidemiological methods and international experience.

Contentious and unresolved issues abound. Nonetheless, the participants engaged in open debate on technical and institutional issues for controlling brucellosis in livestock and humans. One contentious issue is differing strategies among countries for controlling brucellosis in *small ruminants* (Table 1). The veterinary services in seven countries, except those of Georgia, Kazakhstan and Uzbekistan, agree on and are achieving success using whole flock vaccination with ocular Rev 1 vaccine in sheep and goats. Spring and fall twice-yearly whole flock vaccination is carried out in the first and often second year then followed by twice-yearly vaccinating only replacement stock in the subsequent several years. Kazak veterinary authorities intend to conduct in 2013 research by testing various *Brucella* vaccines on several individual farms in a pilot study lasting several years. Uzbek authorities continue to undertake ring vaccination and test and slaughter strategy in infected districts. Georgian authorities have yet to adopt a control strategy.
In some countries both female and male small ruminants are vaccinated while in others only adult and/or immature females are vaccinated. Data on this issue was not consistently collected from country presentations. In large ruminants where vaccination is used, only females are vaccinated, generally as calves but in Turkey both female adults and immatures will initially be vaccinated (with ocular Strain 19).

For large ruminants, there is variation in control strategies (Table 2). Kazakhstan has banned vaccination in large ruminants. Some countries use calfhood vaccination of females for the entire population (Turkey) or limited farms (Tajikistan, Uzbekistan). Other countries do not vaccinate but use test and slaughter exclusively (Albania, Bosnia and Herzegovina, Georgia, Kazakhstan, The Former Yugoslav Republic of Macedonia). Others use only local vaccination around villages, farms or in districts where brucellosis disease persists (Tajikistan, Uzbekistan) with test and slaughter following vaccination in these ‘infected’ areas.

A critical issue in all countries is the availability of compensation when test-positive animals are eliminated on the order of government authorities. Payment of compensation was only recently introduced in some countries and compensation rates vary from 25 to 100 per cent of fair market value. In Uzbekistan compensation consists of the boiled meat being returned to the owner of the test-positive animal. Even if compensation is available, there may be practical constraints such as less than fair-market value paid (Azerbaijan), inefficient and inconvenient in-kind compensation (boiled meat) (Uzbekistan), or lack of local abattoirs for sanitary slaughter (many countries). Other countries lack funds (Tajikistan) even to consider paying compensation. International donors now agree to finance cash compensation at least for a limited time.

Economic theory recommends that governments must quickly and fairly compensate livestock owners when the state confiscates private property (i.e. livestock) even when infected with a zoonotic disease like brucellosis. International experience from many countries is that if fair and timely compensation is not paid, the disease becomes ‘nearly eradicated’ because livestock owners and regulatory authorities collude to avoid slaughter of test-positive livestock. Without adequate compensation, identified diseased animals are frequently sold thus actually spreading the disease wider and faster.

**Draft Roadmap for Progressive Control of Brucellosis in Livestock**

To assist Member Countries in launching and pursuing brucellosis control programmes aimed at controlling and eradicating brucellosis in animals, the FAO has designed a framework for progressive control of brucellosis using a stepwise approach with a roadmap of activities that when followed lead to reduction of brucellosis in livestock and ultimately in humans, eventually leading to the self-declaration of brucellosis-free status as defined by the World Organisation for Animal Health Terrestrial Animal Health Code.

This roadmap entitled: *A Stepwise Approach for Progressive Control of Brucellosis in Livestock and Humans - Principles, Stages, Strategies and Tools* was presented in the workshop. Participants reviewed the first chapters of the draft document describing the four stages of the roadmap.

The process for developing this technical document was elaborated for the workshop participants. Particularly well appreciated were the steps for internal review in FAO, review and comments by OIE and WHO, several formal peer reviews and regional workshops, such as this one in Turkey, where national authorities have the opportunity to comment on the document.
The first change recommended by participants was to remove ‘…and Humans...’ from the title as the document was mainly aimed at national Veterinary Authorities. Nevertheless, they recognized that a major objective of controlling brucellosis in livestock was ‘for the benefit of humans’ to reduce the disease incidence. And indeed, an economic analysis of costs and benefits of brucellosis control must include direct and indirect costs incurred by patients and their families if family members become infected with the disease.

Unfortunately due to high translation costs and extensive peer review comments, only the introductory chapter and STAGES chapter were translated into Russian for review during the workshop. Participants strongly recommended that the entire draft document be translated into Russian. Participants recommended that both English and Russian draft versions be distributed to national veterinary authorities with the request for comments returned to FAO within 60 days.

With the reservations above and suggested changes in the order of some sub-activities, FAO is heartened to receive general endorsement of the draft document. The participants agreed that the concept of a stepwise approach for controlling brucellosis is highly appropriate. They agreed that major domestic livestock species and common species of Brucella should be considered in one document, not several species-specific documents.

FAO’s Animal Health Service will be reviewing each suggested change to the text, order or format, as well as the general tenor of the workshop, to revise the entire document. This is no trivial task. It is hoped that FAO can complete this revision during 2013 and send the document to relevant countries for comments.

Conclusions & Recommendations from the Workshop

Most national authorities from countries in the two regions are generally responding to the resurgence of animal and human brucellosis with redesigned control programmes in small ruminants but continue relying on test and slaughter with or without vaccination strategies for large ruminants. Control of brucellosis in large ruminants is generally not as successful as country authorities wish and review of present strategies is needed.

The control strategy for small ruminants generally relies on field tested strategies using quality assured ocular Rev 1 vaccine for whole flock vaccination in one or more initial years with vaccination of replacement stock in the following years. Frequent out of season breeding of sheep and goats necessitates vaccinating twice-yearly in order to immunize small ruminants at the youngest practicable age and to prevent vaccinating pregnant females thus avoiding vaccine-induced abortions. Vaccinated small ruminants are usually identified by ear-notches. Where strategies based on Rev1 vaccination have been started since about 2007 (2004 in the case of Tajikistan) or more recently, initial monitoring indicates good success in reducing seroprevalence in small ruminants and usually a falling incidence in humans too. In Bosnia and Herzegovina, Kyrgyzstan and Tajikistan, there is evidence that where brucellosis seroprevalence in small ruminants has been significantly reduced using ocular Rev 1 vaccination over several years, the incidence of brucellosis in cattle is reduced too. Veterinary authorities in Kazakhstan realize that brucellosis control programmes implemented over the last years have not reduced the disease in livestock and large sums of money were spent annually. Kazakh vet authorities intend to conduct pilot tests of various vaccines for controlling the disease in small and large ruminants.

Control programmes for large ruminants are primarily based on test and slaughter in those countries having a capable and adequately funded national veterinary service. Brucellosis seroprevalences in large ruminants generally are not well monitored or, where
recent statistically sound surveys have been carried out, are static over the last 10 years or more. Several countries (Azerbaijan, Kazakhstan, The Former Yugoslav Republic of Macedonia) are re-evaluating their test and slaughter strategies in light of lack of progress and continuing high costs.

Conclusions

The Conclusions agreed by two working groups are summarized as follows:

1. The Roadmap document is useful for its intended purpose, i.e. as generic guidelines for country veterinary authorities to prepare and manage a national brucellosis control programme.
2. The participants judged that the guidelines for progressive control should apply to all major domestic livestock species in one document.
3. The concept of the guidelines for progressive control against brucellosis is endorsed as a useful way for national veterinary authorities for planning and implementing of activities to reduce brucellosis in livestock.
4. FAO is requested to prepare a chapter with comprehensive guidelines to national authorities on how to prepare national strategy documents for brucellosis control (chapters: background, rationale, …) including a section on a logical framework map with indicators.
5. The early Roadmap chapters reviewed during the workshop and the workshop report should be translated into both English and Russian and circulated to countries and request their written comments.

The participants also fully endorse the recognition that intersectoral collaboration between veterinarians and public health professionals is essential for a technically sound and effective strategy for controlling brucellosis at the national level.

While recognizing the usefulness of the guidelines, the participants spent considerable time discussing and proposing some changes in the text, in the order of some sub-activities, and they proposed additional text. Participants suggested some changes to the structure of the Roadmap draft document. FAO is requested to include these changes into the final Roadmap chapters.

Recommendations to FAO

FAO is asked to revise the draft document ‘taking into account the discussions, changes and additions proposed during the workshop and with due regard to comments from other workshops on the same subject in other regions. The document name should be modified to, A Stepwise Approach for Progressive Control of Brucellosis in Livestock – Principles, Stages, Strategies and Tools’, as there are few recommendations on controlling brucellosis specifically in humans.

The specific proposals made that FAO is asked to incorporate into the revised document include, among others:

1. Cross cutting activities and outputs be noted and addressed, where practical, into the EXTERNALITIES chapter of Roadmap document, e.g. strengthening veterinary service, capacity building, legislation, training, etc.;
2. A chapter is added to note and elaborate on activities and outputs that may be judged as ‘recommended’ but not fundamentally critical to the strategy for reducing brucellosis transmission (e.g. value chain, socio economic studies, etc.).

Workshop participants prepared two flow charts of activities and expected outcomes (Figure 3) to assist in concept presentation and ease of understanding of the Roadmap. Suggested changes in numbering of the STAGES aim to better reflect the starting brucellosis sanitary status in a country (STAGE 0) and the final status (STAGE 4a and STAGE 4b) of national brucellosis control under current OIE standards. The flow charts also depict the crosscutting issues for comprehensive and holistic strengthening of a national vet services’ capacity which are required to proceed through the various STAGES.

Recommendations to OIE
Recognizing that the OIE has well defined mandates, among these are global dissemination of official animal disease information and for standard setting for the control of animal diseases, and that FAO and WHO have considerable experience in advising countries on implementing activities relating to specific priority diseases, the participants recommend that:

1. OIE proceeds as planned to adopt and publish revised OIE Terrestrial Animal Health Code standards on brucellosis;
2. OIE considers including an appointed member from the FAO and the WHO as members of the ad-hoc group on brucellosis; and
3. OIE considers contributing to the preparation on guidelines for national control strategies and other related documents.

Recommendations to authorities in the participants’ countries
1. National authorities are encouraged to continue sharing data, information and experience related to brucellosis with neighboring countries; and
2. National veterinary authorities and public health authorities are encouraged to strengthen or establish formal mechanisms if appropriate for collaborating and exchanging information on brucellosis.
Figure 1. The new global map of human brucellosis (2000 onwards)
<table>
<thead>
<tr>
<th>Strategy</th>
<th>ALB</th>
<th>AZE</th>
<th>BIH</th>
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<td>Compensation</td>
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<tr>
<td>Sheep / goats</td>
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<td>Y</td>
<td>?</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
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<tr>
<td>Cost recovery</td>
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<td>N</td>
<td>N</td>
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<td>N</td>
<td>N</td>
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<td>Contracts for vets</td>
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<tr>
<td>Annual whole flock vaccination</td>
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<tr>
<td>Whole flock vaccination for several years then only vaccinate young replacements</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
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<tr>
<td>Bi-annual vaccination (twice yearly)</td>
<td>N</td>
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<td>Intermittent / selective vaccination</td>
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1. Compensation set at 25% of market value
2. 100% of market value starting in 2012
3. Starting in 2009 paid 75% of market value
4. 100% of market value
5. 90% of market value
6. Plan for farmers to pay full costs of brucellosis vaccinations by 2013
7. In 2008 – 2009 and following a ‘Willingness to Pay’ study, sheep and goat owners paid ~USD0.12 for each sheep & goat vaccinated and ear-notched
8. Private vets sign contract with state and raion vet departments and are paid KGS6 per female vaccinated and ear notched; livestock owners are willing to pay to have their livestock vaccinated and ear notched
9. Rev 1 ocular vaccination of all small ruminants started in 2012; whole flock vaccination in year 1 and only replacements for 6 – 7 years then start test & slaughter
10. Rev 1 ocular vaccination started in pilot districts in 2007 following a randomly stratified prevalence survey in the whole country; vaccinating females only
11. Rev 1 ocular vaccination started in 2009 then covering whole country by 2011; whole flock vaccination in year 1, replacements thereafter
12. Rev 1 ocular vaccination in pilot districts in Ak-Telaa in 2008 – 2009 then covering whole country by 2011; vaccinate females only
13. Risk based strategy - in high prevalence regions /districts: Rev 1 ocular whole flock vaccination for first year(s) then only vaccinate replacements; in median prevalence regions / districts: use Rev 1 ocular vaccine only on replacement stock
14. From 2004 – 2010: bi-annual vaccination in 20 districts, males and females, with quality assured ocular Rev 1; Sughd Oblast was vaccinated in 2010; ocular Rev 1 vaccination restarted in 2012 in 8 districts in the Rasht Valley which were the original pilot districts started in 2004
15. Rev 1 ocular vaccination started in 2012
16. “Intermittent vaccination” with ocular or subcutaneous Rev 1 is used for control of outbreaks in other districts and on remaining state farms
17. Started in 2005; use Rev 1, full dose (1 x 10⁹) subcutaneous vaccination without revaccination

Table 1. Strategies for brucellosis control in sheep and goats in countries in the regions (2013)
<table>
<thead>
<tr>
<th>Slaughter test-pos / vaccinate test-neg</th>
<th>N</th>
<th>N</th>
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<th>N</th>
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<th>ALB</th>
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<tbody>
<tr>
<td>Test &amp; slaughter – whole country every year</td>
<td>Y</td>
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<tr>
<td>Test &amp; slaughter – outbreaks only / problem villages or districts / part of livestock population only</td>
<td>Y</td>
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<tr>
<td>Outbreak slaughter / vaccinate test-negative animals</td>
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Table 2. Strategies for brucellosis control in **large ruminants** in countries in the regions (2013)

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18 Use test & slaughter in low prevalence regions / districts
19 Rev 1 ocular vaccination started in 2009
20 Used Strain 19 in small ruminants until 2005, now use Russian produced Rev 1
21 Previously used *Brucella abortus* Strain 19 in small ruminants before vaccination ban in 2007
22 Used Strain 19 vaccine for sheep and goats from 1992 through 2006
23 Rev 1 subcutaneous vaccine may be used on state farms and in ‘intermittent’ vaccination areas or for outbreaks
24 Different location of notch in different years of vaccination
25 Ear notch used in some districts but not in common use
26 In process of multi-year programme to ear tag and register all livestock in all oblasts
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<th>GEO</th>
<th>KAZ</th>
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<td>Eradicate</td>
<td>Control</td>
<td>Brucellosis free herds</td>
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<td>Y&lt;sup&gt;29&lt;/sup&gt;</td>
<td>Y?</td>
<td>N</td>
<td>Y&lt;sup&gt;30&lt;/sup&gt;</td>
<td>Y&lt;sup&gt;31&lt;/sup&gt;</td>
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<td>Y&lt;sup&gt;35&lt;/sup&gt;</td>
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<td>Vaccination: heifer calves</td>
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<td>Slaughter test-positive / vaccinate test-negative animals</td>
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</table>

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28 Compensation of ~Euro 800 for cattle  
29 Compensation set at 25% of market value  
30 Said to be at 100% of market value in 2012  
31 Starting in 2009 paid 75% of market value  
32 100% of market value  
33 90% of market value  
34 Compensation rather inconvenient and inefficient; vets boil meat at selected abattoirs then return meat to livestock owner  
35 Livestock owners pay market prices for all livestock vaccinations  
36 Official vaccination of cattle or buffalo was banned since 2007; in 2013 Government intends to test different vaccines for several years in different farms as a pilot study of efficacy of vaccines  
37 RB51 vaccination is practiced in dairy breed cattle on established dairies  
38 S82 calfhood vaccination repeated 2 months before insemination; only used in few cattle in remaining state farms, not country-wide  
39 Starting from 2013, all female cattle (young and adult) will be vaccinated twice with ocular Brucella abortus Strain 19 vaccine. In subsequent years only female calves vaccinated with ocular vaccine until brucellosis prevalence reaches ~1%.  
40 Use Strain 19 for intermittent vaccination in outbreak areas; use Strain 19 for protecting imported cattle
<table>
<thead>
<tr>
<th>Country</th>
<th>Test &amp; slaughter – whole country every year</th>
<th>Test &amp; slaughter – outbreaks only / problem villages or districts / part of population only</th>
<th>Outbreak slaughter / vaccinate test-negative</th>
<th>Vaccine type</th>
<th>Vaccination method</th>
<th>Permanent identification / movement control</th>
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<tbody>
<tr>
<td>ALB</td>
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<td>Strain 19 subcutaneous, calfhood</td>
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<td>Strain 19 ocular vaccine</td>
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<td>Strain 82 ocular vaccine</td>
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<td>Test &amp; slaughter – whole country every year</td>
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<td>Test &amp; slaughter – outbreaks only / problem villages or districts / part of population only</td>
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<tr>
<td>Outbreak slaughter / vaccinate test-negative</td>
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</table>

- **Brucella melitensis** was identified in some outbreaks in cattle
- Testing and slaughter takes place in defined geographic zones
- Test & slaughter with 75% compensation strategy introduced in whole country only in 2011
- 'Ring' or limited vaccination in 'problem' areas following test & slaughter of test-positive reactors
- 1955 to 1973 used Strain 19; 1975 to 1999 used Strain 82 intermittently on remaining state farms
- Using ocular *Brucella abortus* Strain 19 vaccine (5 – 10 x $10^9$ CFU per ml)
- Strain 19 full dose subcutaneous to heifers, then low dose booster (1/25 dose) every 15 months for up to 5 times in problem areas only
- Limited vaccine available and only for cattle in remaining state farms
- RB51 vaccination in heifers of well-defined dairy breeds which are permanently identified and raised on dairies
- Also vaccinate adults with Strain 19
- *Brucella abortus* strain 19 ocular vaccine used in heifer calves and in adults (twice) in the first years of the campaign, then vaccinate only heifer calves
- Intend to permanently identify all cattle (tags or microchips) and register but this is not completed yet in all oblasts
- Few modern farms use ear tags for cattle

Table 3. Trends in brucellosis disease rates in small and large ruminants and in humans in countries in the regions (2013)

<table>
<thead>
<tr>
<th>Trends</th>
<th>ALB</th>
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</table>

55 Since 2008 the number of cases declined from 1,300 in 2008 to 497 in 2012
56 Sheep: no real change in number of outbreaks or cases from 2009 to 2012; Goats: marked drop in outbreaks from 2009 to 2012
57 Calculated apparent prevalence for sheep and goats is 5.15% (ref. Mamisashvili, E. *et al.* Seroprevalence of brucellosis in livestock within three endemic regions of the country of Georgia, *Prev Vet Med.* (2013) 110: 554-557
58 60 to 75% reduction in seropositive animals after 2½ years of Rev 1 ocular vaccination
59 Steep decline in annual number of cases since 2008 when ocular Rev 1 vaccination began; ~11% flocks infected in 2008 to 0.4% flocks infected in 2012
60 From 2003 to 2009, individual animal prevalence decrease by 80% in well vaccinated districts (8), by 40% in less well vaccinated districts (10) and was unchanged in the non-vaccinated districts (19) (ref. Ward, D. *et al.* Brucellosis control in Tajikistan using Rev 1 vaccine: change in seroprevalence in small ruminants from 2004 to 2009, The Vet Record (2012) 170: 100–106)
61 Sheep & goat individual animal prevalence is 4.7% and 30% of flocks infected in 2011
62 Under calfhood vaccination with Strain 19 vaccine and test & slaughter strategy, the number of cases remain about the same from 1,200 in 2003 to 1,500 in 2012
63 260 bovine cases in 2008; fewer outbreaks and cases in 2011 – 2012 since vaccinating small ruminants with Rev 1; bovine case prevalence ~0.02% in 2011 - 2012
65 30% decline in bovine brucellosis seroprevalence where sheep and goats are vaccinated with ocular Rev 1 vaccine
66 Only slight or no decline since 2010 under test & slaughter strategy for cattle; 78 infected herds in 2010 and 64 infected herds in 2012; individual animal prevalence ranges from 0.15 to 0.35% over 3 years but is not consistent; considering to start vaccination in cattle
67 2012 national disease outbreak case data indicate that the number (not prevalence) of reported brucellosis cases in cattle is much less in districts in the Rasht Valley were brucellosis in sheep and goats was reduced by 80% over 5 years; reported cattle cases are in the single digits in the Rasht Valley while cattle cases reported are in the double digits in the rest of the country
68 Cattle individual animal prevalence is 2.6% and 6.9% of herds infected in 2011; bigger herds affected with outbreaks, particularly in 2012
69 Mostly in females; too soon to determine trend following start of Rev 1 vaccination in 2012
70 From 2003 to 2011 only slight drop in human cases (~ 400 to ~360); in 2012, 275 new human cases were reported; this is 4 – 5 years after start of pilot control
71 Marked decline in human cases reported: 994 in 2008 to 53 in 2012; cases decreased by ~ one-half after first year of Rev 1 vaccination
72 Steady decline in new human cases reported in pilot districts with ~70 new cases reported in 2007 to 30 cases reported in 2012; national-wide decline reported in second year following start of Rev 1 vaccination in pilot districts
73 Steep decline in human incidence since 2008 when ocular Rev 1 vaccination began; 485 cases in 2008 to 82 cases in 2012
74 Reported cases declined from 1,476 in 2006 to 841 in 2012
75 Reported human cases were ~15,000 in 2005 and ~7,000 cases in 2012
Figure 2. Flow chart for Activities and Expected Outcomes for national brucellosis control programmes
EXPECTED OUTCOMES

Stage 1
UNKNOWN SITUATION WITH FEW STRUCTURED CONTROL ACTIVITIES

OUTCOME: A BETTER UNDERSTANDING OF THE MAGNITUDE OF THE BRUCELLOSIS DISEASE PROBLEM AND AN AGREED CONTROL STRATEGY

ACTIVITIES 1.1: Baseline assessment in order to understand the prevalence and distribution of the disease

ACTIVITIES 2.1: An agreed National Brucellosis Control Programme (NBCP) strategy and Action Plan based on epidemiological understanding and analysis of the seroprevalence survey

Stage 2
KNOWN SITUATION WITH A CONTROL PROGRAMME UNDERWAY

OUTCOME: BRUCELLOSIS INFECTION RATES ARE FALLING IN LIVESTOCK AND HUMANS

ACTIVITIES 1.1: An agreed population-based NBCP is implemented under the supervision of the Veterinary Authority

ACTIVITIES 1.2: Monitor the NBCP for quality control and for progress

ACTIVITIES 1.3: Obtain socio-economic information on brucellosis disease and its control

ACTIVITIES 1.4: Facilitate Public Health Service and Veterinary Authority collaboration

Stage 3
BRUCELLOSIS AT LOW LEVELS OF OCCURRENCE OR TRANSMISSION WITHIN A LIVESTOCK MANAGEMENT SYSTEM

OUTCOME: BRUCELLOSIS DISEASE IMPACT & RATES CONTINUE TO FALL TO LOW LEVELS IN LIVESTOCK AND IN HUMANS

ACTIVITIES 2.1: Simultaneous vaccination + test and removal are implemented

ACTIVITIES 2.2: Decision made to cease vaccination

ACTIVITIES 2.3: Continuously monitor the NBCP for quality and progress

ACTIVITIES 2.4: Public Health Service and Veterinary Authority continue collaborating

Stage 4
SELF-DECLARED FREEDOM FROM BRUCELLOSIS

OUTCOME: VETERINARY AUTHORITY MAKES SELF-DECLARATION OF FREE FROM BRUCELLOSIS WITH OR WITHOUT VACCINATION ACCORDING TO OIE STANDARDS

ACTIVITIES 3.1: Disease monitoring data support brucellosis free status

ACTIVITIES 3.2: Freedom from brucellosis disease status maintained

ACTIVITIES 3.3: Brucellosis status reported annually

ACTIVITIES 3.4: Public Health Service and Veterinary Authority continue collaborating

National veterinary service capacity improving, legislation adjusted, monitoring & reporting on brucellosis control progress, public awareness of risks & preventive measures, and close coordination with Public Health Service

Level of brucellosis seroprevalence & disease declining in livestock & humans