



# WHEAT RUST DISEASE GLOBAL PROGRAMME



**CRISIS MANAGEMENT CENTRE**  
FOR THE FOOD CHAIN



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## TABLE OF CONTENTS

<b>ABBREVIATIONS AND ACRONYMS</b>	<b>1</b>
<b>EXECUTIVE SUMMARY</b>	<b>2</b>
<b>1 BACKGROUND</b>	<b>3</b>
1.1 INTRODUCTION	3
1.2 SECTORAL CONTEXT	4
<b>2 RATIONALE</b>	<b>7</b>
2.1 ISSUES TO BE ADDRESSED	7
2.2 STAKEHOLDERS AND BENEFICIARIES	9
2.3 STRATEGIC APPROACH AND COUNTRIES COVERED	10
2.4 PAST AND RELATED WORK	11
2.5 FAO'S COMPARATIVE ADVANTAGE	11
<b>3 PROJECT FRAMEWORK</b>	<b>13</b>
3.1 DEVELOPMENTAL GOALS	13
3.2 IMMEDIATE OBJECTIVES	13
3.3 PROGRAMME OUTPUTS AND ACTIVITIES	13
3.4 SUSTAINABILITY	14
<b>4 IMPLEMENTATION ARRANGEMENTS</b>	<b>15</b>
4.1 INSTITUTIONAL FRAMEWORK AND COORDINATION	15
4.2 METHODOLOGY	16
4.3 TECHNICAL SUPPORT AND PROGRAMME STAFF	16
4.4 WORK PLAN AND BUDGET	17
<b>ANNEX 1: OUTPUTS AND ACTIVITIES</b>	<b>18</b>
<b>ANNEX 2: BUDGET AND OUTPUTS</b>	<b>24</b>
<b>ANNEX 3: WORK PLAN</b>	<b>25</b>
<b>ANNEX 4: LOGICAL FRAMEWORK</b>	<b>27</b>

**Abbreviations and Acronyms**

BGRI	Borlaug Global Rust Initiative
CGIAR	Consultative Group on International Agricultural Research
CMC	Crisis Management Centre
CIMMYT	International Maize and Wheat Improvement Center
EMPRES	Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmer field school
GIS	Geographic information system
IARC	International Agricultural Research Centre
ICARDA	International Center for Agricultural Research in the Dry Areas
IFAD	International Fund for Agricultural Development
Ug99	Virulent strain of wheat stem rust

## *Wheat Rust Disease Global Programme*

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### **Executive Summary**

Wheat, grown on more than 200 million hectares of land worldwide, is a source of food and livelihoods for over one billion people in developing countries. This important commodity has been greatly affected by recent soaring food prices. Wheat prices have doubled in the last year, largely as a result of severe drought, the high cost of fuel and an increased demand for grains. In addition, plant disease has placed further constraints on wheat production. Exacerbated by climatic stress, especially in rainfed areas, the impact of disease is expected to increase. By eliciting additional losses in yield, disease causes wheat prices to continue their escalation, in turn creating additional challenges for vulnerable, wheat-reliant populations.

In the past few years the virulent strain of wheat stem rust disease known as Ug99 has emerged from East Africa and spread quickly across borders. Ug99 reached the Islamic Republic of Iran in late 2007, and the disease now threatens the Near East, Eastern Africa and Central and South Asia. These regions account for some 37 percent of global wheat production, and wheat is the staple food crop for most of the countries in these regions. On average wheat provides 40 percent of the per capita calorie supply, and it is especially important to the diets of the most vulnerable. Ug99 is highly virulent for almost all wheat varieties grown worldwide; the risk that it could cause a global epidemic is very real. In Kenya, field trials have shown Ug99 to cause yield losses of up to 80 percent. Moreover, the cost of a 10 percent loss in areas immediately at risk is estimated to exceed USD 7 billion.

Through its Wheat Rust Disease Global Programme, FAO is promoting global action in an attempt to prevent a potential wheat production crisis. The Programme's goal is to contribute to global food security through the prevention and management of emerging wheat rust diseases and the enhancement of wheat productivity. To achieve this goal, FAO is working in close collaboration and partnership with national governments, International Agricultural Research Centres and other international institutions.

The Programme reinforces and complements the activities of the Borlaug Global Rust Initiative and FAO's Initiative on Soaring Food Prices. Through the Wheat Rust Disease Global Programme, FAO is taking the lead in supporting the efforts of national governments and the international community to manage the Ug99 epidemic and to prevent similar wheat rust crises in the future.

The Programme covers 29 countries in the regions of East and North Africa, the Near East and Central and South Asia. It involves countries already affected by Ug99 or at risk of Ug99 introduction by varying degrees. With a total budget of nearly USD 74 million over four years, the Programme covers five main components at the national level. These are: (i) support to national policy for preparedness and contingency planning; (ii) enhancement of surveillance and early warning systems, including virulence tracking; (iii) enhancement of national wheat varietal registration programmes for the release of resistant varieties; (iv) enhancement of seed systems for quick multiplication and distribution of quality seeds of resistant varieties; and (v) improvement of wheat rust management at the field level through participatory farmer training to reduce risk and improve yields under local farming conditions.

The Wheat Rust Disease Global Programme emphasizes regional and international cooperation and information sharing. FAO is well positioned to lead such international efforts through its status as a neutral international forum and through its linkages with rural communities, national governments, regional bodies, international agriculture research and development institutions and the donor community.

## ***Wheat Rust Disease Global Programme***

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### **1 BACKGROUND**

#### **1.1 Introduction**

The recent crisis of soaring food prices is one of the challenges the world faces in attempts to reduce hunger and poverty. Moreover, a solution seems unlikely in the near future. In some countries, the rising price of food has even led to political unrest.

Wheat has been one of the major victims of this phenomenon. As with other grain crops, wheat prices have doubled in the last year, largely as a result of several years of severe drought, the high cost of fuel and an increased demand for grains. Any additional reduction in wheat yields would result in further price increases.

Wheat is grown on more than 200 million hectares of land and is a source of food and livelihoods for over a billion people in developing countries. The Near East, East and North Africa and Central and South Asia alone account for some 37 percent of global wheat production. In most countries in these regions, wheat is the staple food crop, providing on average some 40 percent of the per capita calorie supply. Wheat is especially important in the diets of the most vulnerable, and many people in these countries rely heavily on wheat production for their subsistence and livelihoods.

Rising prices are not the only problem these vulnerable populations face, however. With wheat crops coming under pressure from climatic stress, especially in rainfed regions, the impact of diseases is also expected to increase, resulting in severe yield losses. A major new threat has already surfaced - Ug99, a virulent strain of stem rust, also scientifically known as TTKS, an important fungal disease of wheat. In 1999, Ug99 emerged in East Africa, and by late 2007 it had reached the Islamic Republic of Iran. Ug99 is highly virulent for almost all wheat varieties currently grown throughout the world, and the risk that it could cause a global epidemic is very real. If this happens, wheat production would suffer devastating yield losses.

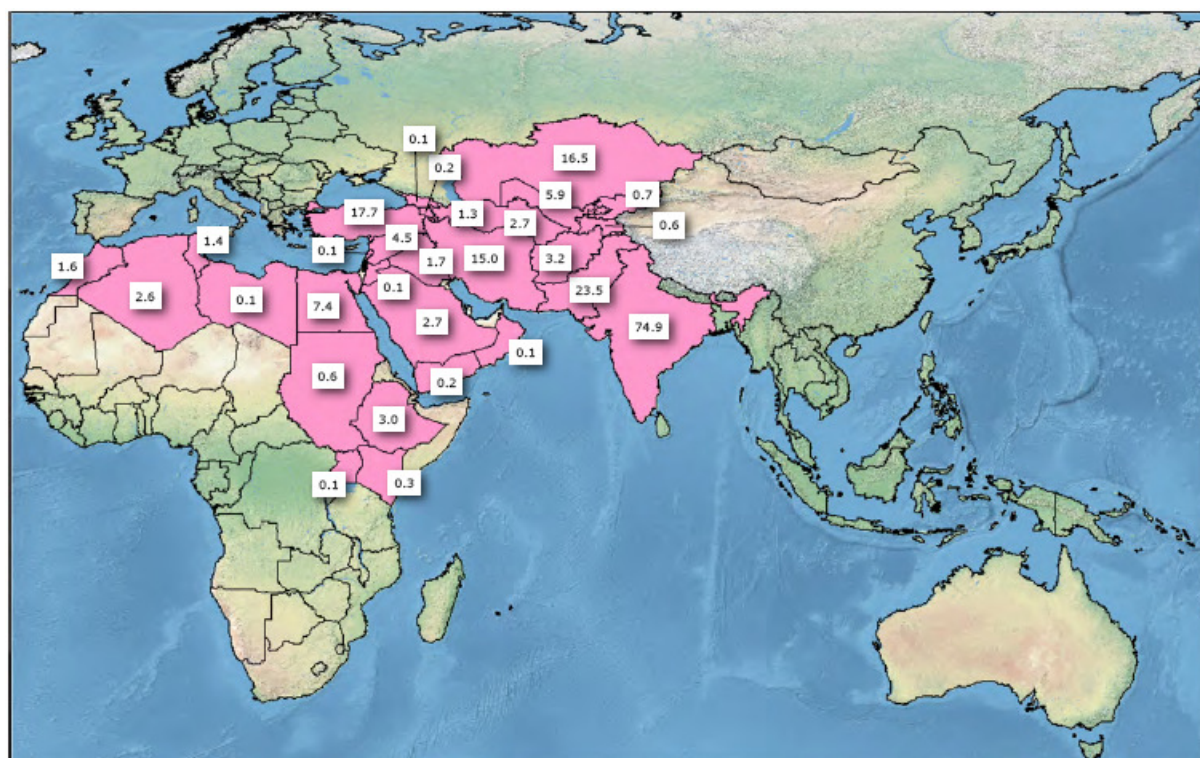
Based on weather patterns and previous experiences with similar rust strains, Ug99 is likely to affect all countries in the Near East, East and North Africa and Central and South Asia in only a matter of years. These countries cultivate around 80 million hectares of wheat. With a realistic assumption that Ug99 might cause an average yield loss of 10 percent at a wheat price of USD 400 per ton, the value of losses in these countries would reach over USD 7,5 billion (Figure 1).

Though some climate-related agricultural disasters may be difficult to predict and prevent, those resulting from pests and diseases are often the result of unsound agriculture-related policies, mismanagement of resources, and insufficient national and regional preparedness for prevention and early response. These areas require attention at all levels and with all stakeholders, including farmer communities, governments and the international community. For too many years governments have reduced their investments in agriculture, especially with respect to farmer education and extension, agricultural research, rural development through infrastructure, and market access.

Through its Wheat Rust Disease Global Programme, the Food and Agriculture Organization of the United Nations (FAO) is taking global action to prevent a wheat production crisis. FAO is working in close collaboration with national governments, International Agricultural Research Centres (IARCs) and other international institutions to manage the Ug99 threat and to prevent future crises caused by similar wheat rust diseases. FAO is well positioned to lead such international efforts because of the Organization's: (i) experience with the international dimensions of other transboundary pests such as locusts; (ii) position as a neutral international forum for information sharing; and (iii) linkages with grassroots rural communities, national governments, regional bodies, international agriculture research and development institutions, the private sector and the donor community.

## Wheat Rust Disease Global Programme

Figure 1: Wheat cultivation in countries\* affected by and at direct risk of Ug99



\*Countries threatened by Ug99 produce 37 percent of the world's wheat. Figures in boxes indicate 2006 wheat production in millions of tons.

### 1.2 Sectoral context

Wheat yields are affected by various abiotic and biotic stresses. Drought has been very important in causing yield losses, especially in recent years, because most of the wheat grown in the developing world is rainfed. Of the biotic stresses, wheat rusts are definitely the most important diseases that reduce wheat yields at the global level. The most important wheat rusts, a group of diseases caused by fungal pathogens, are stem rust (also called black rust), stripe rust (also called yellow rust), and leaf rust (also called brown rust). Although all three are present wherever wheat is grown, weather and other conditions cause some rust types to be more prevalent and severe in some regions, while others are more destructive elsewhere.

Rust fungi have been known to attack wheat since the earliest records of its cultivation - in classical times, the Romans made sacrifices to Robigus, the Rust God, to protect their wheat from epidemics. Rust fungi produce a large number of spores (i.e. inocula) that are carried by wind. When environmental conditions are favourable and wheat varieties susceptible, they may cause severe epidemics resulting in yield losses of over 60 percent.

Wheat rusts can be controlled worldwide by planting resistant varieties of wheat. Fungicides may be biologically effective, but for wheat rust they are not economically feasible. Fungicides are only recommended when based on accurate monitoring data and as an emergency control measure until resistant wheat varieties are again available. There is also a high risk that pathogens may develop resistance to fungicides, rendering them ineffective. Cultural practices such as changing planting dates, destroying volunteer and alternate host plants, employing early maturing varieties and using multi-lines or varietal mixtures are also recommended because they are effective in reducing the levels of inocula and disease.

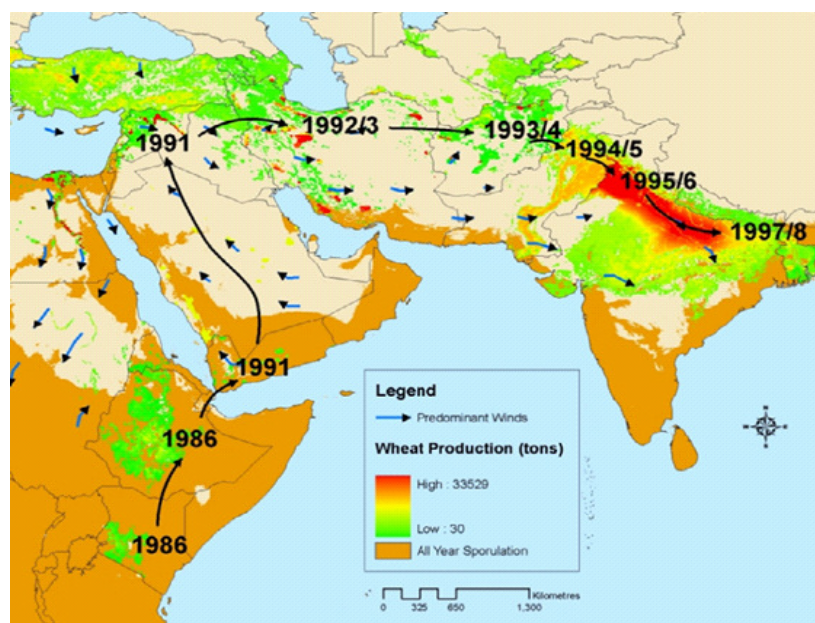
However, rust control using resistant varieties has faced the limited durability of resistance. For decades, wheat rust resistance breeding followed by national wheat

## Wheat Rust Disease Global Programme

breeding programmes and the international research centres has been based on the deployment of a few genes that are sufficiently potent to preclude rust spore production even if the plant possesses only a single gene. However, these genes are race-specific and function only if the infecting rust population is of a pathotype that lacks virulence with regard to those specific genes. Against the rapid rate of change in the genetic make-up of rust populations induced by mutation and selection pressure from current resistance breeding strategies, the increasingly narrow deployment of resistance in the field is easily overcome by the pathogen. As a result, most of the wheat varieties currently grown worldwide are at continuous risk of becoming susceptible to the selection of new virulent wheat rust strains. The recent explosion of Ug99 has dramatically revealed this genetic vulnerability.

During the 1980s and 1990s, the world experienced a series of major epidemics of wheat stripe (yellow) rust due to a breakdown of the yellow rust resistance gene Yr9, present in several cultivars that were grown in South, West and Central Asia. The virulent strain of this rust moved from East Africa, where it was first detected, through Yemen to the Near East and into Central Asia, Pakistan and India (Figure 2). This caused crop losses amounting to several hundred million dollars and affected the livelihoods of millions of poor farmers.

Figure 2: Yellow rust pathway (1986-1993)



The emergence of Ug99, the new virulent strain of the wheat stem rust fungus, is expected to become a similar potential global threat to wheat production. Studies have shown that Ug99 defeats virtually every race-specific resistance gene used in commercial varieties grown throughout the world. It is estimated that over 90 percent of all wheat varieties planted along its potential pathway are now highly susceptible to Ug99, despite having been resistant to stem rust since the Green Revolution.

Since the Ug99 strain was first identified in East Africa in 1999, it has spread to other countries, including the Sudan, Yemen and most recently the Islamic Republic of Iran in the Near East in late 2007. The arrival of Ug99 in the Near East poses a new and heightened risk to wheat production in Asia. Typical weather patterns and experience with prevailing winds<sup>1</sup> suggest that countries to the east (i.e. Afghanistan, India and Pakistan) are most at risk, followed by the countries of the Caucasus and Central Asia (i.e. Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Turkmenistan and Uzbekistan). Furthermore,

<sup>1</sup> Based on desert locust forecasting studies



## ***Wheat Rust Disease Global Programme***

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rust fungus is easily transported short distances by wind gusts, which puts most countries of the Near East (i.e. Egypt, Iraq, Jordan, Lebanon, the Syrian Arab Republic and Turkey) at similar risk. Ug99 is expected to affect North African countries at a later date.

In response to Ug99, the Global Rust Initiative was first established in 2005 and later expanded to what is now known as the Borlaug Global Rust Initiative (BGRI)<sup>2</sup>. It includes the International Center for Agricultural Research in the Dry Areas (ICARDA), the International Maize and Wheat Improvement Center (CIMMYT), Cornell University and FAO. Both ICARDA and CIMMYT are IARCs of the Consultative Group on International Agricultural Research (CGIAR) and share the global mandate for wheat improvement. The overall objective of BGRI is to systematically reduce the world's vulnerability to stem, yellow and leaf rusts of wheat by advocating and facilitating the evolution of a sustainable international system to contain the threat of wheat rusts and consolidating the enhancements in productivity required to withstand future global threats<sup>3</sup>.

To date, the activities of BGRI have concentrated on three main pillars:

- analysis of pathogen isolates to support and improve surveillance and monitoring;
- capacity building through human resource development and infrastructural scientific enhancement; and
- accelerated breeding, multiplication and distribution of resistant replacement wheat varieties.

Activities have already been initiated in an increasingly coordinated fashion by all BGRI partners, most of whose mandates are primarily for research and education. Their wheat rust activities and national partners are therefore linked to research in the sectors of pathotyping, breeding and, to a limited extent, seed multiplication. FAO, through the Wheat Rust Disease Global Programme, complements these research efforts by working directly with governments and national authorities. This work focuses on the policy and regulatory issues especially related to national contingency planning and to enhanced national, regional and international cooperation in surveillance, monitoring and early warning, information exchange, improved varietal registration, seed multiplication and distribution systems to ensure the quick availability of quality seeds of resistant varieties to the most vulnerable farmers. The Programme also focuses on participatory farmer training to ensure proper management in the field to reduce disease risk and optimize yields under local ecological and farming conditions. The Programme covers activities at the farm, district, national, regional, and international levels. Furthermore, it fully reinforces and complements the activities of FAO's Initiative on Soaring Food Prices.

<sup>2</sup> Named after its chair, U.S. agronomist Dr Norman Borlaug, Nobel Peace Prize winner in 1970 and widely acclaimed as the "father of the Green Revolution".

<sup>3</sup> An expert panel report, "Sounding the Alarm on Global Stem Rust," issued 29 May 2005 (see [www.globalrust.org](http://www.globalrust.org))

## 2 Rationale

### 2.1 Issues to be addressed

Recognizing that wheat rusts are recurrent potential threats, actions that reduce the risk of spread and allow for quick response to and management of these threats have to be undertaken at the national, regional and global levels.

#### 2.1.1 Advocacy and policy support in contingency planning

Any national action to prevent or manage the threat of Ug99 requires the consensus and support of the national authorities. Governments will need support in devising contingency plans for dealing with potential wheat rust epidemics. Contingency plans should include *specific strategies and scenarios and the corresponding actions needed* to deal with the risk that Ug99 or similar virulent wheat rust strains that lead to widespread disease outbreaks and yield losses. Contingency plans should help governments respond to potential emergencies with minimum time, cost and loss. Governments should be supported in identifying their critical resources and the functions needed for the implementation of the contingency plans and in their documentation, testing and regular update.

The main elements of contingency plans for wheat rust diseases include:

1. multidisciplinary / multi-institutional teams representing all concerned national stakeholders and sectors in the process of developing such a plan;
  - Planning will involve units of the national plant protection, agricultural research, breeder and seed sectors (i.e. public, private and informal systems), extension services and wheat farmer organizations.
2. a monitoring process with key factors that trigger the initiation of planned actions within the contingency plans; and
  - Surveillance and monitoring of the occurrence of rusts in the field and monitoring the shifts in virulence of wheat rusts through trap nurseries and pathotyping of field samples as well as early warning systems could be developed when harmonized national and regional data are available (refer to section 2.1.2).
3. immediate action and long-term measures to respond to emergencies and their future mitigation.
  - Action to reduce the build-up of pathogen populations includes:
    - changing planting dates and using early maturing or shorter duration varieties to reduce the number of generations/cycles of pathogen in a given season;
    - elimination through tillage or herbicides application on "Green Bridges" - susceptible wheat / barley and wild grasses growing out of season or in abandoned fields, that would carry rust populations during a period normally not cultivated;
    - strip planting and creation of patchwork field layouts of different varieties with different resistance profiles; and
    - planting varietal mixtures or multi-lines when available within the same field.
  - Action to improve systems for quick varietal registration and release are listed in section 2.1.3.

## ***Wheat Rust Disease Global Programme***

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- Action to improve national seed systems should allow resistant varieties to move quickly through the national regulatory systems, be quickly multiplied and effectively distributed to the most vulnerable farmers who are at highest risk (refer to section 2.1.4).
- Support to the education of farmers in field management practices for disease risk reduction and improved implementation of contingency plans are listed in section 2.1.5.
- Socio-economic impact assessments related to wheat production and losses from rust diseases will be needed to allow for a better rationalization of national contingency plans.

### **2.1.2 Surveillance, monitoring and early warning**

Rust surveillance and the monitoring of spread and change in the virulence pattern of wheat rusts is the basis for early response and reaction. Key to the process of surveillance is regularity as well as coordinated information sharing for timely decision-making and response.

Disease surveillance includes the assessment of disease incidence and severity in wheat growing areas. It also includes pathotyping of the wheat rusts causing disease on previously resistant varieties, and tracking the virulence changes in the rust populations using field trap nurseries. A variant of the Ug99 that differs from the type identified in Kenya and Uganda has already been detected in Yemen, and this variant is able to overcome even more of the wheat resistant genes in the cultivated varieties.

Pathotyping for Ug99 and other wheat rusts require special greenhouse and laboratory facilities and human skills. Most of the countries affected by or at risk from Ug99 do not possess such facilities or skills. Currently, all rust samples are sent to the United States of America or Canada for pathotyping. Besides being a costly process, this increases the risk of spreading virulence into new regions. It is limited through logistical procedures that result in delays and uncertainties in the results obtained. The availability of the necessary greenhouse and laboratory facilities and trained personnel to permit virulence analysis at the regional or preferably national level is a priority for pathogen monitoring.

The availability of reliable, harmonized and regular disease survey data as well as information on wheat growing areas and the varieties grown is the basis for the development of an early warning system. The commitment of national counterparts to share survey data will be a major contribution. On this basis, FAO will develop a global early warning system for wheat rusts.

### **2.1.3 Improving the breeding strategies and development of wheat rust resistant varieties**

As indicated above, wheat breeding strategies for a number of years involved the stacking or pyramiding of pathotype-specific genes. While early action measures to stack genes could be considered, longer term breeding solutions through durable host plant resistance should be advocated strongly. Global efforts to improve wheat breeding strategies for durable resistance are already under way. Searches for sources of resistance to Ug99 from existing wheat varieties and wild wheat relatives and conventional and modern breeding technologies are being carried out. The international research centres and various advanced research and academic institutions worldwide are studying durable resistance (i.e. Cornell University is implementing a large-scale wheat programme).

In order to quickly replace susceptible wheat varieties with new resistant varieties, countries will need support to enhance the effectiveness of their national systems for varietal registration and release, through which all potentially resistant varieties must pass before they can be multiplied for distribution. Multilocation adaptation trials, pest and

## ***Wheat Rust Disease Global Programme***

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disease resistance trials and quality testing are required. In addition, all old and new varieties must be tested for their susceptibility to Ug99 and its variants in the international Ug99 nurseries in Njoro, Kenya (for bread wheat) and in Debra Zeit, Ethiopia (for durum wheat) before they can be released and multiplied. Currently, several varieties showing resistance to Ug99 have been identified within the breeding material of the joint ICARDA-CIMMYT wheat improvement programme, and two Ethiopian resistant varieties are already being multiplied for distribution to farmers in that country.

### **2.1.4 Enhanced seed systems for multiplication and distribution of resistant varieties**

Before rust resistant wheat varieties are nationally registered and ready for release, a national strategy should already be in place for the multiplication and distribution of quality seed of rust resistant varieties to replace rust susceptible varieties. Although some of the countries threatened by Ug99 already have a system for seed multiplication, modifications may be needed to cope with the urgency of large-scale rapid multiplication and distribution of Ug99 resistant varieties, especially to serve the most vulnerable small farmers. Production urgency should not compromise the quality of certified seeds. Many of the countries will therefore require training and some basic equipment to maximize the yield obtained from early generation seed multiplication. Support will be required for the nation-wide establishment of demonstration plots to popularize among farmers the varieties that will be released.

### **2.1.5 Wheat rust disease management in the field**

Extension services and farmer education have been given too little attention in recent years in most of the countries threatened by Ug99. Participatory farmer education methods have proved to be extremely effective, empowering farmers with strong observation and decision-making abilities. Properly trained farmers will be a major support to the implementation of national contingency plans. They could help in early recognition and reporting of changes in disease severity and virulence in the field, and in understanding the risks associated with virulent strains and the importance of the various field management practices (planting dates, planting periods, choice of varieties, etc.) for disease development and yield improvement.

## **2.2 Stakeholders and beneficiaries**

The beneficiaries of this Programme are the most vulnerable wheat growers and consumers in East Africa, Near East and Asia in particular. Governments and policy-makers in these countries will directly benefit from the Programme's enhancement of their abilities to develop and implement contingency plans allowing for quick response to and early rehabilitation in present and future wheat rust crises.

However, given that it is only a matter of time before Ug99 moves globally, wheat producers in all parts of the world, whether in developing or developed countries, will also benefit from the Programme, because it should lead to: (i) a reduction in the build-up of the strain's inocula; (ii) improved assessment of its movement and changes in its virulence; and (iii) increased international cooperation in breeding for resistance and information sharing for management practices.

Wheat is not only the staple food crop in many parts of the world; it is also a commodity on the international market. Diseases such as Ug99 that threaten to cause reductions in yield may result in uncontrolled increases in international wheat prices, thus threatening food security, the livelihoods of millions of vulnerable people who depend on wheat as their staple food and world trade markets.

## Wheat Rust Disease Global Programme

Beneficiaries of this Programme will be the international research institutions whether within the IARCs or advanced research institutes and universities. These include international, public and private breeding institutions.

### 2.3 Strategic approach and countries covered

FAO's Wheat Rust Disease Global Programme falls within the scope of the Organization's Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES). Specifically, the EMPRES plant programme focuses on emergency prevention and early warning for transboundary plant diseases. Preventing the Ug99 threat from becoming a global crisis requires immediate action at the national level in countries at risk. However, measures can only be effective through strong regional and international collaborative action.

While some countries will require support in capacity building, equipment and infrastructure, all countries will require policy support for contingency planning and knowledge and information sharing. Better exchange of information on surveillance, pathogen virulence shifts, breeding results and scientific achievements is critical for decision-makers to set national priorities and contingency planning in both developing and developed countries. As neutral fora, FAO and its IARC partners can play a leading role in the exchange of information and genetic materials.

The programme will work closely and primarily with national governments. Discussions, meetings and workshops will be the basis for awareness raising, needs assessments and consensus on the most adapted and effective national options and action to take. Governmental concurrence will be required for sharing national information at the global level (as with FAO's Desert Locust Information System), and for assigning focal points responsible for sharing that information. National and regional workshops and meetings will be the basis on which the Programme will: (i) prioritize activities; (ii) decide modes of implementation; and (iii) establish methods for updating contingency plans.

The Programme will cover 29 countries (see table 1), representing most wheat-producing countries either already affected or at direct risk from Ug99 and its variants. However, the Programme will not cover all countries equally. The scope of activities, length of the implementation phase and level of funding will vary by country according to the: (i) local needs; (ii) importance of wheat production to food security; and (iii) risk of Ug99 infection.

Table 1: Countries included in the Wheat Rust Disease Global Programme

A. Countries already affected by Ug99	B. Countries at immediate risk
1. Ethiopia	7. Afghanistan
2. Iran (Islamic Republic of)	8. Eritrea
3. Kenya	9. Iraq
4. Sudan	10. Oman
5. Uganda	11. Pakistan
6. Yemen	
C. Countries at high risk	D. Countries at risk
12. Armenia	26. Algeria
13. Azerbaijan	27. Libyan Arab Jamahiriya
14. Egypt	28. Morocco
15. Georgia	29. Tunisia
16. India	
17. Jordan	
18. Kazakhstan	
19. Kyrgyzstan	
20. Lebanon	
21. Syrian Arab Republic	
22. Tajikistan	
23. Turkey	
24. Turkmenistan	
25. Uzbekistan	

## ***Wheat Rust Disease Global Programme***

The Programme foresees the possibility of contingency activities taking place for other wheat-producing countries not in the above-mentioned list should problems related to Ug99 arise.

### **2.4 Past and related work**

FAO has been involved in activities related to the management of the Ug99 crisis since the alarm was sounded by Dr Norman Borlaug, 1970 Nobel Peace Prize winner, during the Rust Summit in Nairobi, Kenya, in September 2005. FAO participated in the Rockefeller Foundation supported Nairobi summit and during which the Global Rust Initiative (later renamed BGRI) was officially launched and endorsed by all countries and institutions attending the summit.

Since the Rust Summit, FAO has convened, in cooperation with its BGRI partners, several expert meetings and workshops in Rome to share international knowledge on the status of the disease and risk of its spread, virulence changes, breeding developments and potential breeding strategies and options for field disease management and international cooperation.

BGRI partners have been active in developing projects both jointly and independently to obtain funds in support to help countries manage the Ug99 crisis. Apart from its own funds, BGRI has obtained funds from the United States Agency for International Development, the Canadian International Development Agency, the Indian Council of Agricultural Research, the Arab Fund for Social and Economic Development, the International Fund for Agricultural Development (IFAD) and Cornell University.

Funds have been used to support countries affected by or at risk of Ug99, mostly in capacity building (i.e. surveillance, pathotyping and breeding) and infrastructure support.

FAO's Wheat Rust Disease Global Programme will be implemented through a number of complementary projects funded by various donors including FAO. FAO has already secured funds for field activities over the next three years totalling over USD 1.7 million. Funding sources include the Spanish and Italian Trust Funds and Cornell University's special project on "Durable Rust Resistance in Wheat". Activities include capacity building in pathotyping and field surveillance as well as coordination meetings for awareness raising, needs assessment and preparation for contingency planning.

### **2.5 FAO's comparative advantage**

#### **2.5.1 Policy support to national authorities in emergency prevention, contingency planning, coordination and information sharing**

FAO works closely and directly with governments and is therefore best situated to provide policy advice and advocacy in the areas of prevention, contingency planning and rehabilitation through the development of scenarios and action plans. These include disease surveillance and monitoring, national and international information sharing and enhancement of national varietal registration and seed systems for the quick availability of resistant replacement varieties to the most vulnerable farmers.



**Figure 3: Participants to the Nairobi Summit visiting the Ug99 disease international nursery in Njoro, Kenya (2005)**

## ***Wheat Rust Disease Global Programme***

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### **2.5.2 Surveillance and monitoring of disease occurrence and severity in the field coupled with analysis of changing pathogen virulence**

Through the EMPRES Desert Locust programme, FAO has experience in building and training surveillance teams in the field, and in establishing monitoring and early warning systems; FAO is well positioned to enhance national coordination between the National Agriculture Research System and the plant protection units of ministries to combine field disease survey data with scientific virulence tracking data.

### **2.5.3 Networking, international cooperation and knowledge sharing, including awareness raising, advocacy and early warning**

Through working closely with national governments, most recently with its Initiative on Soaring Food Prices, FAO is best placed to raise awareness on and advocate with policy- and decision-makers the importance of information sharing at the national, regional and international levels; FAO is also well positioned to lead in the development of an international early warning system for Ug99 and other potential virulent wheat rust strains.

### **2.5.4 National multiplication and distribution of seeds of resistant adapted replacement varieties to the most vulnerable farmers**

FAO has vast experience with national seed systems in its member countries through policy support for national regulatory frameworks and regional harmonization, and capacity building activities in the formal and informal seed systems for multiplication and distribution of quality seeds as well as in emergency and rehabilitation activities with national authorities and farmers.

### **2.5.5 Capacity building of small farmers for disease management in the field**

Through farmer field schools (FFSs), FAO has a large network of trained farmers and facilitators in many of the countries affected by or at risk of Ug99 and can therefore take a lead in supporting farmers management of the disease at the field level (i.e. trained and empowered farmers provide the necessary support to governments in the implementation of contingency plans in the field).

### **2.5.6 Accelerated varietal registration and release procedures and regulations for quick replacement of susceptible wheat varieties**

Breeding activities and identification and development of resistant varieties is beyond the scope of FAO's activities and falls within the mandate of its research partners within the BGRI. However, through its work with national governments, FAO has a critical role to play in providing policy and technical support to enhance the process of national varietal registration and release procedures (e.g. through support to multilocation adaptation, pest and disease resistance trials and quality testing). FAO's Global Plant Breeding can also facilitate the breeding capacity building activities to be provided to national counterparts through BGRI partners.

### **2.5.7 Socio-economic and livelihood surveys and impact assessment of wheat producers**

Through its specialized social, economic and livelihoods units, its emergency activities and its various comprehensive databases as well as through its close cooperation with the World Food Programme (WFP), FAO is most suited to lead the assessment of socio-economic risks and impacts of wheat rust diseases on the livelihoods of rural communities. This will be carried out in close cooperation with partner IARCs and national counterparts, and it is particularly important in view of food security and the international wheat trade and prices.

## ***Wheat Rust Disease Global Programme***

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### **2.5.8 FAO and emergency response**

FAO has decade-long experience in emergency response, recovery and rehabilitation in a number of countries that are either affected by or at risk of Ug99. This is particularly true for countries in East Africa as well as Pakistan and Afghanistan, where FAO Emergency Coordination Units have contributed over the past decade to on-farm production and storage of seeds, building on the local knowledge and development of farmer-based seed enterprises.

## **3 PROJECT FRAMEWORK**

### **3.1 Developmental goals**

The goal of FAO's Wheat Rust Disease Global Programme is to contribute to global food security through the prevention and management of emerging wheat rust diseases and the enhancement of wheat productivity.

### **3.2 Immediate objectives**

The Programme focuses on preventing rust epidemics in wheat producing countries at significant risk through improved preparedness and policy support, enhanced national surveillance and monitoring, strengthened national variety registration and seed systems and proper field management.

### **3.3 Programme outputs and activities**

FAO has defined achievement of its immediate objectives in terms of the following five critical outputs to be achieved through a series of concrete activities. See Annex 1 for more detail.

#### **Output 1: Policy support to preparedness and contingency planning provided**

Policy support to countries for the enhancement of their preparedness in facing emergency situations through advocacy, development of contingency plans and regional cooperation provided through the following activities:

- 1.1 conduct socio-economic and yield loss assessments in the countries affected by the disease or at direct risk;
- 1.2 carry out advocacy and awareness raising for policy-makers and the international community;
- 1.3 provide policy support to countries for the development and implementation of national contingency plans; and
- 1.4 provide support for regional coordination mechanisms.

#### **Output 2: Surveillance and early warning systems enhanced**

In order to enhance the establishment of an effective and sustainable national surveillance system for wheat rust disease monitoring, including pathotyping and the establishment of a global early warning system to support decision-making for implementation of preventive actions and control operations, the following activities will be carried out:

- 2.1 provision of policy and technical support for the establishment of effective and sustainable national surveillance teams;
- 2.2 direct support to national wheat rust surveys and virulence monitoring through harmonizing surveillance protocols and strengthening national disease surveillance and pathotyping capacities;
- 2.3 support to regional interaction and information exchange;



## ***Wheat Rust Disease Global Programme***

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- 2.4 establish a wheat rust early warning system at FAO.

### **Output 3: National wheat varietal registration programmes for release of resistant varieties enhanced**

In order to strengthen national varietal registration programmes and international exchange of information and material in support of the development of durable rust resistant wheat varieties, the following activities will be carried out:

- 3.1 assess wheat rust disease resistance breeding capacities/varietal registration and areas for improvement of individual countries;
- 3.2 based on the assessment, provide technical support to countries in national multilocation adaptation and pest and disease resistance trials for rust resistant varieties;
- 3.3 based on the assessment, provide policy and technical support to national strategies and varietal release procedures; and
- 3.4 provide policy support to countries for improving international cooperation in testing breeding material and information exchange.

### **Output 4: Seed systems for quick multiplication and distribution of resistant varieties enhanced**

In order to strengthen national seed systems for the quick multiplication and distribution of resistant replacement varieties, the following activities will be carried out:

- 4.1 work with national authorities to popularize adapted rust resistant varieties among farmers through seed campaigns, including field demonstration plots;
- 4.2 strengthen systems for early generation seed multiplication of rust resistant varieties in each country;
- 4.3 with national authorities, develop and support a strategy for the multiplication and distribution of quality seed of rust resistant varieties to replace rust susceptible varieties through both the public and private sector; and
- 4.4 strengthen the National Seed Certification Agency's database through a national variety catalogue of released varieties and information on quantities of certified seeds available, including information on significant pests and diseases for each variety and their tolerance to these pests and diseases, in particular Ug99 rust strains.

### **Output 5: Wheat rust management at the field level improved**

In order to enhance the wheat field management practices of farmers through participatory methodology, the following activities will be carried out:

- 5.1 reach agreement with the various national authorities on the establishment of participatory methods such as FFS to support wheat farmers in proper field management;
- 5.2 support to identified or established farmer groups or FFSs;
- 5.3 support to farmer groups through season-long participatory training; and
- 5.4 develop training and reference wheat management guides for farmers and facilitators, based on local experiences.

## **3.4 Sustainability**

While a number of activities are urgently required, it is envisaged that the initial phase of the proposed Programme will last four years with the possibility of extension. It will cover 29 countries that differ greatly in development status, human and infrastructure

## ***Wheat Rust Disease Global Programme***

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capacities, the relative importance of wheat in the economy and the level of risk of being affected by Ug99. All these factors will affect the success of Programme implementation and the sustainability of its activities.

Within the duration of the Programme, participating countries will have acquired the necessary infrastructure and sufficient critical mass of trained scientists able to undertake surveys and pathotyping. A system will be in place to share information within each country and at regional and global levels. Equipment and technical capacities for wheat variety evaluation and registration and the quick multiplication and distribution of replacement resistant varieties will be available. National strategies for seed increase and distribution will also be in place, and this should permit sustainability of these activities. Within the duration of the Programme, a critical mass of wheat farmers and facilitators will have been trained and empowered through participatory methods enabling them to improve their productivity, reduce the risk of diseases and support their national extension systems.

The activities of the proposed Programme respond to the needs of governments in facing the threat of Ug99, and incorporate a system that enables countries to face and prevent threats from other virulent wheat rust strains that might emerge in the future. Because the Programme deals with prevention and risk reduction, the awareness of policy-makers of the risks and consequences of lack of preparation and preventive measures and the development of appropriate contingency plans and their implementation are probably the most critical factors for sustainability of the Programme's activities. As a result, these have been given adequate attention. The Programme's activities will contribute to safeguarding wheat production in these countries, which will contribute to long-term sustainable economic, social, and political stability.

## **4 IMPLEMENTATION ARRANGEMENTS**

### **4.1 Institutional framework and coordination**

FAO will implement the Wheat Rust Disease Global Programme in close collaboration with the recipient institutions (i.e. the Ministries of Agriculture of participating countries). FAO's Plant Production and Protection Division and FAO's Emergency Operations Service will execute the Programme in the framework of the Plant Pests component of the Crisis Management Centre for the Food Chain (CMC-FC). The CMC-FC will operate under the technical supervision of the Chief Plant Protection Officer and the operational responsibility of the Chief of the Emergency Operations Service.

Technical activities will be coordinated through a technical team led by the Lead Technical Officer of the Plant Production and Protection Division at FAO headquarters. This team will include a Regional Technical Coordinator in each region covered by the Programme (i.e. Near East, South Asia, and Central Asia/Red Sea). A team from the Food Chain Emergencies Management Unit of the Emergency Operations Service (TCEO-FCEMU) at FAO headquarters will coordinate operational activities, in close cooperation with emergency coordinators and operations officers in the concerned regions and countries.

Work will be carried out in close collaboration with the FAO Representatives in the countries involved, with the relevant FAO Regional and Subregional Offices and the Emergency Coordination Units. The Programme will work in synergy with ongoing emergency and rehabilitation activities implemented by FAO in the various countries. The Programme team will actively liaise with all stakeholders and agencies in order to: (i) avoid duplication of efforts; (ii) ensure complementarities with other initiatives; and (iii) promote local ownership of Programme activities.

Technical guidance will be provided by: (i) staff from the Plant Production and Protection Division; (ii) the Regional Technical Coordinators; (iii) international and national

## ***Wheat Rust Disease Global Programme***

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consultants; and (iv) relevant technical staff from BGRI partners, including ICARDA, CIMMYT and Cornell University.

The Ministries of Agriculture of the participating countries act as the government counterpart institutions responsible for implementation. The Ministries will make available the services of qualified staff as necessary and ensure the clearance of Programme inputs free from custom duties.

As a member of the BGRI, the Programme will benefit from the technical and scientific guidance of the BGRI Executive and Technical Committees, which include participants from the National Agricultural Research Systems of the concerned countries. This will also ensure coordination between Programme activities and those of BGRI.

The Programme will have an FAO Oversight Committee responsible for overseeing the operational and managerial implementation of the programme. The Committee will ensure that activities are delivered in a proper and timely manner as per the work plan, donor requirements and the overall vision and priorities of FAO.

### **4.2 Methodology**

The general methodological approach will be consultative. At an early stage of the process, regular national and regional meetings and workshops will be held with national counterparts to raise awareness with policy-makers on the Programme's components, and to assess country situation and needs. Based on these consultative meetings, the most appropriate and adapted modes for the implementation of national activities, including the development of contingency plans, will be identified and a work plan will be agreed. National focal points will be appointed and given the authority to communicate, coordinate and share information with FAO, its partners and other identified stakeholders.

The Programme will focus on capacity building and support in the provision of infrastructure and equipments.

### **4.3 Technical support and programme staff**

Technical and operational support for the Programme will be provided through the following human resources:

- a Lead Technical Coordinator, based in Rome, responsible for overall technical coordination of the Programme;
- an Assistant Programme Manager, based in Rome, responsible for supporting the Lead Technical Coordinator in his/her tasks, liaising with the Regional Technical Coordinators and responsible for the preparation of project proposals;
- a Monitoring and Forecasting Specialist, based in Rome, responsible for the development of a Global Cereal Rust Monitoring System and the technical backstopping of national teams in effective cereal rust tracking and monitoring;
- an Information Expert based in Rome;
- three Regional Technical Coordinators based in the regions of the Near East (one in Cairo [at the FAO Regional Office for the Near East] or in Aleppo [at ICARDA], one in South Asia [preferably in India], and one in either Central Asia [possibly at FAO's Subregional Office for Central Asia in Ankara] or in the Red Sea region);
- an International Programming and Operations Officer, based in Rome, primarily providing operational support to the entire Programme at HQ as well as to the Regional Technical Coordinators;
- a National Assistant to each of the Regional Technical Coordinators, stationed in the regions;

## ***Wheat Rust Disease Global Programme***

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- Regional Operations Officers stationed in the regions and providing support to the Regional Technical Coordinators;
- Subject Matter Specialists (international consultants): wheat breeders, seed specialists, plant pathologists, agronomists, geographic information system specialists, database/information technology specialists, socio-economists, communication specialists.
- Subject Matter Specialists (national consultants);
- national focal points for surveillance and monitoring activities and for seed multiplication and support to improved field management; and
- FAO headquarters staff from the operational and technical divisions ensuring adequate operational and technical backstopping to the Programme.

### **4.4 Work plan and budget**

While in response to an urgent need, FAO's Wheat Rust Disease Global Programme combines both short and medium to longer term activities. The recommended activities and related budget within this Programme document (Annex 2) refer to an initial four-year period, which may be modified in the light of emerging issues and special projects funded within the Programme.

The timing of implementation of Programme activities will be directly related to the risk of Ug99 in the various countries. The level of support to each country will also be dependent on the estimated need for infrastructure, capacity building and area planted to wheat in the country. Beneficiary countries within this Programme could be grouped into the four categories indicated below based on the presence or risk of being affected by Ug99:

1. countries already affected by Ug99;
2. countries at immediate risk;
3. countries at high risk; and
4. countries at risk.

The work plan over the four initial years based on the categories of beneficiary countries is shown in Annex 3. The logical framework of the Programme is presented in Annex 4.

### **ANNEX 1: Outputs and activities**

#### **Output 1: Policy support to preparedness and contingency planning provided**

Policy support to countries for the enhancement of their preparedness in facing emergency situations through advocacy, development of contingency plans and regional cooperation provided through the following activities:

##### **1.1 *Conduct socio-economic and yield loss assessments in the countries affected by the disease or at direct risk***

- Conduct socio-economic and yield loss assessments in Kenya, Ethiopia, the Sudan, Yemen and the Islamic Republic of Iran.
- Conduct socio-economic and disease risk assessment studies in the other countries of the Near East, Central and South Asia.
- Through these assessments, identify the most vulnerable farmers and communities
- Build and mainstream scaling-out approaches (linking with GIS wheat maps and superimposing pockets of poverty).
- Ensure linkage of results with contingency, development and research interventions to improve targeting and focus on most vulnerable segments.

##### **1.2 *Carry out advocacy and awareness raising for policy-makers and the international community***

- Hold regional and international meetings for high-level policy-makers and technical decision-makers to inform them on all aspects of Ug99 including its status, potential path of spread, availability of resistant varieties, and actions being taken at the international level, specifically by FAO and its partners within BGRI.
- Prepare for and distribute to the countries concerned awareness and information material addressed to different audiences and in various languages.

##### **1.3 *Provide policy support to countries for the development and implementation of national contingency plans***

- Organize national and regional meetings to assess country situations in terms of status of systems for surveillance and monitoring, seed information, multiplication and distribution, breeding structures and needs, coordination and information exchange within the country and regionally, availability of national information on wheat growing areas, agro-ecological systems and agricultural landscapes, social vulnerability, and political and administrative structures.
- Organize national and regional meetings for the development of the most appropriate policy options and strategies and actions needed for risk reduction, disease prevention and control of wheat rusts, including strategies for the multiplication of quality basic seed of rust resistant varieties to replace rust susceptible varieties through both the public and private sector, and strategies for the establishment of long-term sustainable and effective surveillance and reporting systems.
- With national authorities, assess requirements for implementation of suggested contingency actions.

## ***Wheat Rust Disease Global Programme***

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- Support countries in implementation of contingency plans through provision of capacity building, infrastructure development, regulatory support (registration of varieties and pesticides, etc.), and information and knowledge systems.
- When necessary, carry out required control operations in full collaboration with national authorities.
- Review and update contingency plans on the basis of the latest information on the status of wheat rusts from field surveys and global analysis.

### ***1.4 Provide support for regional coordination mechanisms***

- Provide policy support for regional cooperation as a support mechanism for national contingency planning.
- With the relevant policy-makers, develop mechanisms for networking and information and experience sharing at the regional and international levels.
- Organize regional and international policy-makers' meetings to assess and coordinate national contingency plans at the regional level, and exchange information and experiences.

### **Output 2: Surveillance and early warning systems enhanced**

In order to enhance the establishment of an effective and sustainable national surveillance system for wheat rust disease monitoring, including pathotyping, and the establishment of a global early warning system to support decision-making for implementation of preventive actions and control operations, the following activities will be carried out:

#### ***2.1 Provision of policy and technical support for the establishment of effective and sustainable national surveillance teams***

- Hold national and regional meetings to assess the national status of wheat field surveys (i.e. regularity, unit carrying out surveys, methodology, information sharing, responsibilities of various units and limitations and constraints).
- Technical and policy support provided to agree with national authorities on:
  - the most appropriate structure for the establishment of sustainable and coordinated multi-institutional surveillance teams;
  - the type and level of survey information to be officially shared and exchanged regionally and internationally;
  - the national focal point(s) or way to ensure quality of national survey data and its transmission to concerned parties nationally and internationally; and
  - the long-term surveillance programme and identification of lead institutions.
- Establish coordinated surveillance teams and obtain the nomination of a national focal point to coordinate national activities with FAO

#### ***2.2 Direct support to national wheat rust surveys and virulence monitoring through harmonizing surveillance protocols and strengthening national disease surveillance and pathotyping capacities***

- Conduct regional workshops for harmonization of surveillance methodologies, survey work plans, national responsibilities and compilation of available information in wheat distribution maps.
- Agree the number and location of rust trap nurseries.
- Assess national surveillance material, infrastructure and human capacities.

## ***Wheat Rust Disease Global Programme***

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- Provide necessary field survey support equipment, including global positioning systems, computers and printers and vehicles.
- Upgrade laboratories and greenhouses in key countries and equip them with the infrastructure and material necessary for pathogen characterization.
- Establish national rust trap nurseries in several key positions in each country and record the results.
- Train relevant national staff in field surveys pathotype analysis, including field rust trap nurseries.
- Direct support to undertake surveys.
- Support national focal points.

### **2.3 *Support to regional interaction and information exchange***

- Organize national and regional workshops and field days in order to ensure continuous national and regional interaction.
- Create a FAO wheat rust surveillance website for enhancing public awareness and advocacy, updating the global situation of virulent wheat rusts in the field, and relevant scientific, regulatory and development information.
- Prepare awareness materials on the disease risks and status for distribution.

### **2.4 *Establish a wheat rust early warning system at FAO***

- Establish a GIS system for incorporating national and regional wheat maps, national survey disease data and field trap nurseries information.
- Ensure the availability of updated meteorological data.
- Verify nationally developed maps.
- Incorporate available information on community vulnerability and socioeconomic surveys into maps.
- Establish a wheat rust early warning system using national field surveys, trap nursery data, national and regional wheat crop distribution patterns, and meteorological data.
- Predict occurrence and disease risk.
- Establish an information dissemination system to issue recommendations on disease status, alert levels and recommended actions for prevention and control addressed to relevant national, regional and international stakeholders and public awareness (i.e. website and bulletins).

### **Output 3: National wheat varietal registration programmes for release of resistant varieties enhanced**

In order to strengthen national varietal registration programmes and international exchange of information and material in support of the development of durable rust resistant wheat varieties, the following activities will be carried out:

#### **3.1 *Assess wheat rust disease resistance breeding capacities/variety registration and areas for improvement of individual countries***

- Undertake baseline assessments on the current situation of wheat rust disease resistance breeding, variety development and registration capacities in the countries concerned using available data from FAO's Global Initiative for Plant Breeding and the relevant IARCs, ICARDA and CIMMYT, and in close cooperation with national programmes.

## **Wheat Rust Disease Global Programme**

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- Organize national workshops to identify the support needed by countries in terms of capacity and institution building for national testing and release of rust resistant wheat varieties.

### **3.2 *Based on the assessment, provide technical support to countries in national multilocation adaptation and pest and disease resistance trials for rust resistant varieties***

- In close cooperation with ICARDA and CIMMYT and other leading advanced breeding institutes, provide the technical support needed in the area of breeding methodologies, varietal multilocation adaptation testing and disease resistance trials through study tours of IARCs and training.
- Provide the necessary equipment for varietal quality testing and harvesting field trials.

### **3.3 *Based on the assessment, provide policy and technical support to national strategies and varietal release procedures***

- In close cooperation with ICARDA, CIMMYT and the International Treaty for Plant Genetic Resources for Food and Agriculture, organize national workshops to provide policy and technical support on the development of national strategies for varietal registration and the implementation of varietal release procedures, and on opportunities and limitations regarding the exchange of wheat resistant genetic material.
- Provide the technical training needed for the implementation of varietal release procedures.
- Support to the establishment of a database for released varieties including attributes of resistance to the new rust virulence.
- Prepare awareness material in the relevant languages on the procedures of varietal testing and release.

### **3.4 *Provide policy support to countries for improving international cooperation in testing breeding material and information exchange***

- Provide policy, technical and financial support for establishing international and regional agreements and cooperation for testing national breeding material in international wheat rust nurseries (where a virulent pathogen is already present) and in sending infected wheat samples to advanced pathotyping laboratories (i.e. when facilities and capacities are not available nationally).
- Organize regional workshops for information exchange on the status of pathogen virulence, available resistant breeding material, and mechanisms for cooperation in the fields of material and information exchange.

## **Output 4: Seed systems for quick multiplication and distribution of resistant varieties enhanced**

In order to strengthen national seed systems for the quick multiplication and distribution of resistant replacement varieties, the below-mentioned activities will be carried out.

### **4.1 *Work with national authorities to popularize adapted rust resistant varieties among farmers through seed campaigns, including field demonstration plots***

- Organize demonstration plots in all wheat growing areas of each of the concerned countries to enable farmers to observe new varieties and learn about wheat rusts and better wheat production practices (it is assumed that because the entire production area will not be covered in the first year, new demo plots will be established each year to cover the whole country within 3-4 years).



## ***Wheat Rust Disease Global Programme***

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- Organize training sessions for farmers at the demo plots on the assessment and evaluation of agronomic and quality characteristics of the new varieties.
- Organize training sessions for extension workers on the management of demonstration plots.
- Prepare awareness material on the characteristics of various resistant varieties and their field management.

### ***4.2 Strengthen systems for early generation seed multiplication of rust resistant varieties in each country***

- Where necessary, support countries through the training of technical staff in procedures for early generation seed production to minimize disease and maximize the yield for the quantity of seed provided.
- Provide countries with the equipment needed for early generation seed multiplication including production-related equipment, irrigation systems, seed cleaners, small scale equipment, and agricultural inputs.
- Support seed multiplication including the cost of water, labour, inputs and fuel.
- Wherever existing<sup>4</sup>, FAO Emergency Coordination Units will facilitate variety diffusion and seed exchange using FAO's extensive network and experience in strengthening local seed systems (experience has demonstrated that taking the local seed system as a starting point offers many opportunities for improving seed supply).

### ***4.3 With national authorities, develop and support a strategy for the multiplication and distribution of quality seed of rust resistant varieties to replace rust susceptible varieties through both the public and private sector***

- Organize workshops in support of the development of a national strategy for seed multiplication, distribution and varietal replacement (workshops are to be held at the district and national levels and should include participants from various concerned ministries and public boards, the private sector, farmers associations, and civil organizations directly or indirectly involved in the seed sector).
- Wherever Emergency Coordination Units exist, they will facilitate linkages between different seed systems and actors in order to overcome the weaknesses and optimize the strengths of both systems.
- Follow-up workshops should be also organized at the national and district levels for updating implementation of the strategy.

### ***4.5 Strengthen the National Seed Certification Agency's database through a national variety catalogue of released varieties and information on quantities of certified seeds available, including information on significant pests and disease for each variety and their tolerance to these pests and diseases, in particular Ug99 rust strains***

- Organize a national workshop in preparation for the establishment/strengthening of the National Seed Certification Agency's seed inventory database.
- Provide the necessary hardware and software support for establishing/strengthening the seed database.
- Provide the necessary training for database management and updating.

<sup>4</sup> Afghanistan, Ethiopia, Kenya, Pakistan, the Sudan, Tajikistan and Uganda.

## ***Wheat Rust Disease Global Programme***

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### **Output 5: Wheat rust management at the field level improved**

In order to enhance farmers' wheat field management practices through participatory methodology, the following activities will be carried out:

#### **5.1 *Reach agreement with the various national authorities on the establishment of participatory methods such as FFS to support wheat farmers in proper field management***

- Organize national workshops with concerned stakeholders to discuss and agree on:
- the participatory methods (FFSs or variations thereof) most adapted for the national extension system;
- the plan of work for the support of established farmer groups or FFSs, including the location and number of experimental sites, and training needed; and
- in countries where FFSs are already available, identify areas for their enhancement and their adaptation to the wheat crop.

#### **5.2 *Support to identified or established farmer groups/FFS***

- Train selected extension agents in participatory methods and as facilitators, and in wheat production techniques;
- Where FFSs already exist and facilitators are already active, use training-of-trainers techniques to update them on wheat systems in particular.
- Organize national refreshers workshops for extension agents and facilitators to exchange field experiences and update their knowledge of participatory approaches.

#### **5.3 *Support to farmer groups through season-long participatory training***

- Establish experimental farmer sites/on-field trials for farmers' training or FFS when one or the other already present or is accepted as a participatory extension method.
- Train farmers over the whole season using participatory methods on wheat field management practices using agro-ecosystem analysis, experimentation in local ecologies, and farmers' indigenous knowledge and experience (training will emphasize rusts, varietal selection and seed multiplication).
- Organize national and regional travelling workshops and field days to exchange field experiences.

#### **5.4 *Develop training and reference wheat management guides for farmers and facilitators, based on local experiences***

- Produce reference guides and FFS training manuals on wheat production and protection to be used by FFS farmers and facilitators.

## Wheat Rust Disease Global Programme

### ANNEX 2: Budget and outputs

BUDGET (USD)		
COMPONENT DESCRIPTION	TOTAL COST	%
Total cost in the countries (see next table for details)	54,941,746	74.4
Regional coordination (three units)	8,927,780	12.1
Global coordination	9,975,781	13.5
<b>Total</b>	<b>73,845,308</b>	<b>100</b>

Estimated cost per output and per country category based on the presence or risk of being affected by Ug99 (USD)

COUNTRIES <sup>2</sup>	OUTPUTS <sup>1</sup>					TOTAL	%
	1	2	3	4	5		
Countries already affected	686,441	1,897,536	558,060	3,247,492	5,021,234	11,410,764	21
Countries at immediate risk	589,500	1,773,741	465,050	2,637,032	3,777,388	9,242,712	17
Countries at high risk	1,592,961	4,581,728	1,302,141	6,221,195	9,857,758	23,555,783	43
Countries at risk	400,860	1,173,761	372,040	1,606,061	1,862,821	5,415,544	10
Other countries	350,332	1,010,011	288,996	1,469,119	2,198,486	5,316,943	10
TOTAL	3,620,094	10,436,778	2,986,288	15,180,900	22,717,686	54,941,746	100
%	6.6	19	5.4	27.6	41.3	100	

#### 1) Outputs

Output 1: Policy support to preparedness and contingency planning provided

Output 2: Surveillance and early warning systems enhanced

Output 3: National wheat varietal registration programmes for release of resistant varieties enhanced

Output 4: Seed systems for quick multiplication and distribution of resistant varieties enhanced

Output 5: Wheat rust management at the field level improved

#### 2) Country categories

Already affected: Ethiopia, Iran (Islamic Republic of), Kenya, Sudan, Uganda, Yemen

At immediate risk: Afghanistan, Eritrea, Iraq, Oman, Pakistan

At high risk: Armenia, Azerbaijan, Egypt, Georgia, India, Jordan, Kazakhstan, Kyrgyzstan, Lebanon, Syrian Arab Republic, Tajikistan, Turkey, Turkmenistan, Uzbekistan

At risk: Algeria, Libyan Arab Jamahiriya, Morocco, Tunisia

Other: Miscellaneous to be determined based on disease development

## ANNEX 3: Work plan

Calendar of activities by component and category of country

Countries / Activities	Already affected *				At immediate risk *				At high risk *				At risk *			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>Output 1 - Policy support to preparedness and contingency planning</b>																
1.1 Socio-economic and yield loss assessments in the countries affected by the disease or at direct risk																
1.2 Advocacy and awareness raising for policy-makers and the international community																
1.3 Policy support to countries for the development and implementation of national contingency plans																
1.4 Policy support in regional coordination mechanisms																
<b>Output 2 - Enhancement of surveillance and early warning systems</b>																
2.1 Policy and technical support for the establishment of effective and sustainable national surveillance teams																
2.2 Support to national wheat rust surveys and virulence monitoring																
2.3 Support to regional interaction and information exchange																
<b>Output 3 - National wheat rust disease resistance breeding/variety development programmes for release of resistant varieties</b>																
3.1 Assess wheat rust disease resistance breeding capacities/variety development and areas for improvement of individual countries																
3.2 Technical support to countries in national multilocation adaptation and pest and disease resistance trials																
3.3 Policy and technical support to national strategies and variety release procedures																
3.4 Policy support to countries for improving international cooperation in testing breeding material and information exchange																

Countries / Activities	Already affected *				At immediate risk *				At high risk *				At risk *				
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
<b>Output 4 - Seed systems for quick multiplication and distribution of resistant varieties enhanced</b>																	
4.1 Popularize adapted rust resistant varieties among farmers through seed campaigns, including field demonstration plots																	
4.2 Strengthen systems for early generation seed multiplication of rust resistant varieties in each country																	
4.3 Support a strategy for multiplication and distribution of quality seed of rust resistant varieties to replace rust susceptible varieties																	
4.4 Strengthen the database of the National Seed Certification Agency for seed inventories																	
<b>Output 5 - Wheat rust management at the field level improved</b>																	
5.1 Agree with the various national authorities on the establishment of participatory methods for proper field management																	
5.2 Support to identified or established farmer groups/FFS																	
5.3 Support to farmers' groups through season-long participatory training																	
5.4 Develop training and reference wheat management guides for farmers and facilitators																	

Countries already affected: Ethiopia, Iran (Islamic Republic of), Kenya, Sudan, Uganda, Yemen

Countries at immediate risk: Afghanistan, Eritrea, Iraq, Oman, Pakistan

Countries at high risk: Armenia, Azerbaijan, Egypt, Georgia, India, Jordan, Kazakhstan, Kyrgyzstan, Lebanon, Syrian Arab Republic, Tajikistan, Turkey, Turkmenistan, Uzbekistan

Countries at risk: Algeria, Libyan Arab Jamahiriya, Morocco, Tunisia

Other countries: Miscellaneous to be determined based on disease development

## ANNEX 4: Logical framework

Objective	Verifiable indicators	Means of verification	Assumptions
<p>Contribute to reduction of the world's vulnerability to emerging wheat rust diseases, and facilitate the evolution of a sustainable international system to reduce the risk and contain the threat of wheat rusts and continue the enhancements in productivity required to withstand future global threats to wheat.</p>	<p>Current yield losses due to stem wheat rust reduced</p> <p>Cereal rust monitoring and early warning systems developed</p> <p>National contingency plans developed and action taken</p> <p>Small farmers provided with replacement seeds of Ug99 resistant varieties</p> <p>International and regional cooperation and information exchange enhanced</p>	<p>FAO reports</p> <p>Reports of BGRI partners (ICARDA, CIMMYT and Cornell University)</p> <p>Reports from national systems</p> <p>Policy-makers' meeting reports</p> <p>Website on wheat rusts</p>	<p>National authorities cooperate and agree on disease surveillance and sharing information</p> <p>Availability of funds</p>

Purpose

Verifiable indicators

Means of verification

Assumptions

Prevent rust epidemics in wheat producing countries through the strengthening of national seed systems, improved surveillance, monitoring and preparedness, and proper field management.

Surveillance systems in place and functional in concerned countries

Contingency plans reflecting a change in wheat cultivation policy in place in concerned countries

Pathotyping facilities and capacities upgraded and functional in directly affected countries

Seeds of resistant varieties multiplied and distributed to small farmers in countries affected by or at direct risk from Ug99

Wheat rust monitoring system in place at FAO, alert bulletins issued and awareness material distributed

FAO reports

Reports of BGRI partners (ICARDA, CIMMYT and Cornell University)

National agricultural research reports

Alerts bulletins issued

Rust website developed with situation reports on regional rust distribution

Governments cooperate in disease surveillance and information sharing

Availability of resistant varieties

Availability of funds

Outputs	Verifiable indicators	Means of verification	Assumptions
1. Policy support to preparedness and contingency planning	Contingency plans reflecting a change in the wheat cultivation policy in place in at least 6 countries Action taken by at least 3 countries for the implementation of the contingency plans Socio-economic / impact assessment conducted	FAO, and other BGRI partners' reports Reports from national systems Socio-economic / impact assessment report Policy meeting / workshops proceedings	Governments willing to commit to national and regional coordination and information sharing Availability of funds
2. Enhancement of surveillance and early warning systems	Harmonized surveillance systems established Surveillance teams in at least 10 countries established, trained and equipped At least 40 persons trained in pathotyping Wheat rust surveys conducted Pathotyping facilities (laboratories and greenhouses) and staff trained in at least 6 countries upgraded and functional Wheat rust monitoring system in place at FAO Coordination and early warning systems established Wheat rust website established at FAO Alert bulletins issued and awareness material distributed	National surveillance reports Trap nursery reports Training reports Wheat rust website Alert bulletins issued Awareness material FAO and other BGRI partners'	Cooperation of Governments in information sharing and support to national surveillance Availability of funds



<p>3. National wheat rust disease resistance breeding/variety development programmes for release of resistant varieties</p>	<p>Efficient varieties registration system in place in at least 6 countries  Trainings in variety data base management and implementation of variety release procedures undertaken  Databases for released varieties including attributes of resistance to the new rust virulence established in at least 6 countries  National and regional workshops undertaken to improve exchange of information and genetic material</p>	<p>FAO, and other BGRI partners' reports  Reports from national systems  Published awareness material on the procedures of variety testing and release  Reports from the workshops and meetings</p>	<p>Government ready to cooperate in improving variety registration regulations and in information sharing   Availability of funds</p>
<p>4. Seed systems for quick multiplication and distribution of resistant varieties enhanced</p>	<p>Resistant varieties identified and basic material increased  Seeds multiplied by various stakeholders  Major seed producers (public, private or farmers) in the country trained  Seeds from resistant varieties distributed to small farmers in at least 6 countries affected by Ug99 or at direct risk</p>	<p>FAO, and other BGRI partners' reports  Reports from national systems indicating the varieties and quantities multiplied  Training reports  List of farmers receiving seeds of resistant varieties</p>	<p>Availability of wheat varieties with still undefeated rust resistant genes  Variety registration system in place in the concerned countries for quick adoption of the varieties  Availability of funds</p>
<p>5. Wheat rust management at the field level improved</p>	<p>At least 5 pilot sites for participatory training established in each country  At least 35 facilitators identified and trained  At least 35 Farmers Field Schools (FFS) established and running in the countries affected by Ug99 or at direct risk  At least 1000 farmers trained countries affected by Ug99 or at direct risk</p>	<p>Meetings reports  Training of Trainers reports  Lists of farmers and FFS registered and receiving support  FFS curricula developed</p>	<p>Identification of proper sites and facilitators  Agreement of the Governments to release facilitators  Availability of funds</p>