Food and Agriculture Organization of the United Nations

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وزارة البيئة والمياه والزراعة
Ministry of Environment Water & Agriculture

Situation analysis of rainfed wheat cultivation in Riyadh and Al-Qassim regions

CRL/051/2022/2

Strengthening MoEWA's Capacity to implement its Sustainable Rural Agricultural Development Programme (2019-2025) (UTF/SAU/051/SAU)

Food and Agriculture Organization of the United Nations

Riyadh, Kingdom of Saudi Arabia

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1. INTRODUCTION

The component on rainfed cereals in the SRAD project focuses on 'Development of rain-fed cereals production' with the objective to sustainably increase crop productivity through targeted technology packages, innovative practices and value addition opportunities for small holders and farmers. The main targeted crops are Sorghum (*Sorghum bicolor*), Pearl Millet (*Pennisetum glaucum*) and Sesame (*Sesamum indicum*) that are grown in the South-West of the country mainly in Al Baha, Aseer, Makkah and Jazan. Wheat is also grown under rainfed conditions in Aseer, Al Baha and Jazan regions. Due to food security considerations MEWA prioritizes wheat production in the Kingdom and several measures were introduced recently to stimulate increase in local grain area and productivity. The attention is also given to local rainfed wheat production in the Central regions of the country. Traditionally farmers without access to irrigation grow wheat after the rainfall in November and December taking advantage of the moisture during the winter season. The potential of rainfed wheat production was estimated by MEWA around 600 ha in Riyadh region and 5,000 ha in Qassim. There is lack of knowledge on the environment, wheat growing conditions, production practices, post-harvest and processing of wheat in the rainfed regions. MEWA formally requested FAOSA Cereals group staff to undertake a mission for appraisal and evaluation of the current practices of rainfed wheat production in Riyadh and Qassim regions to identify the challenges and develop potential improvement opportunities. The objective of the current report is to summarize the current knowledge on rainfed wheat production in central regions of KSA and develop enhancement recommendations based on existing reports, publications, field mission to Riyadh and Qassim regions in April 2022, stakeholders interviews using wheat survey tool, group and individual discussions.

2. RAINFED WHEAT PRODUCTION IN RIYADH AND QASSIM REGIONS

According to the General Authority for Statistics 2018 report total wheat cultivated area in Riyadh and Qassim regions. The GAS data does not provide separate values for irrigated and rainfed wheat. However, the estimates from MEWA specify the production areas of rainfed wheat (Table 1, Annex 1) with the total exceeding 5,700 ha. Considering that total wheat production area in the country in 2020 was 87,000 ha, the rainfed area contributes only 6.5%. Contribution to production quantity is likely to be below 3% since rainfed yield are at least compared to irrigated. However, the potential for growing rainfed cereals and their contribution to food security needs thorough evaluation within and beyond the specified areas.

Table 1. Distribution of rainfed wheat production in Riyadh and Qassim regions (Source: MEWA)

Governorate	Location name	Cultivated area (hectares)	Number of farms	Property
Riyadh region				
Diriyah-Al Uyaynah	Uyaynah Park	200	1	Public
Thadiq	Kindergarten Akherimh	16.7	1	Public
Az Zulfi*	Rawdat Alsabalah	67.6	1	Public
Al Ghat	Shoaib Alhasky	227.6	-	Public
Al Hariq	Triple click	50.0	1	Public
Qassim region				
Al Asyah	Khasiybah	25.0	5	Private
Al Asyah	Hunaydhl	50.0	10	Private
Al Asyah	Aba Alworood	60.0	10	Private
Al Asyah	Turaif	25.0	2	Private
Ash Shimasiyah*	Alnamlat abu bisbas	1,000.0	50	Public
Ash Shimasiyah*	Om dubar	800.0	25	Public
Ar Rubayiyah	Almustawi	1,200.0	40	Public
Ar Rubayiyah	An Nabgy shamal	500.0	80	Public

Ash Shimasiyah*	Al Nabaqih	600.0	30	Public
Ash Shimasiyah*	Al Shaflahya	600.0	25	Public
Al Mithnab	Rawdat almurabae	250.0	-	Public
Total		5,671.9	281	

* - governorates visited during the mission in April 2022.

3. NATURAL RESOURCES FOR RAINFED WHEAT PRODUCTION

There are variable soil types in the rainfed wheat target governorates listed in Table 1. Evaluation of General Soil Map (MEWA, 1985) indicated that there is substantial area with soil suitable for crop production in all rainfed regions. The mission also witnessed a number of crop fields which were previously used for irrigated production but now abandoned. This indicates that land is available for rainfed farming in central regions.

The climatic features of the Riyadh and Qassim regions indicate very clear area North of Riyadh and North-East of Buraydah with relatively high annual rainfall approaching 200 mm (Figure 1) (Kucera et al. 2010). This is the main reason of rainfed crops cultivation in Qassim region.

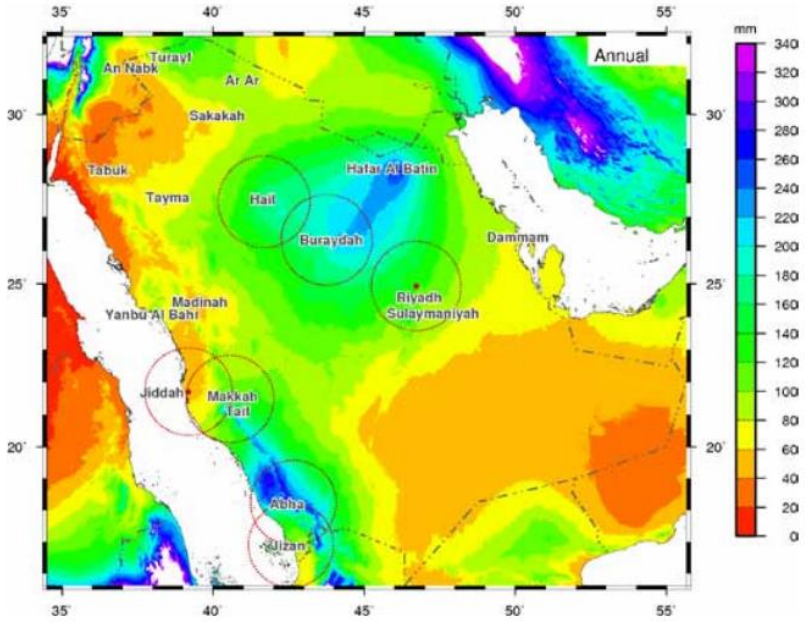


Figure 1. Distribution of annual rainfall in Saudi Arabia (Kucera et al. 2010).

The real precipitation recorded in 2020 in Riyadh and Buraydah were very low not exceeding 40 and 70 mm, respectively (Figure 2). There are two main spikes in rainfall utilized by farmers to grow crops: November-December and April. End of the year rainfall provides the opportunity for farmers to cultivate soil and conduct planting. April spike in rainfall is hardly used by wheat due to its maturity by that time. However, some late planted wheat may benefit from April rainfall. Unpredictability of rain and its amount remains a key limiting factor for rainfed wheat production in central regions.

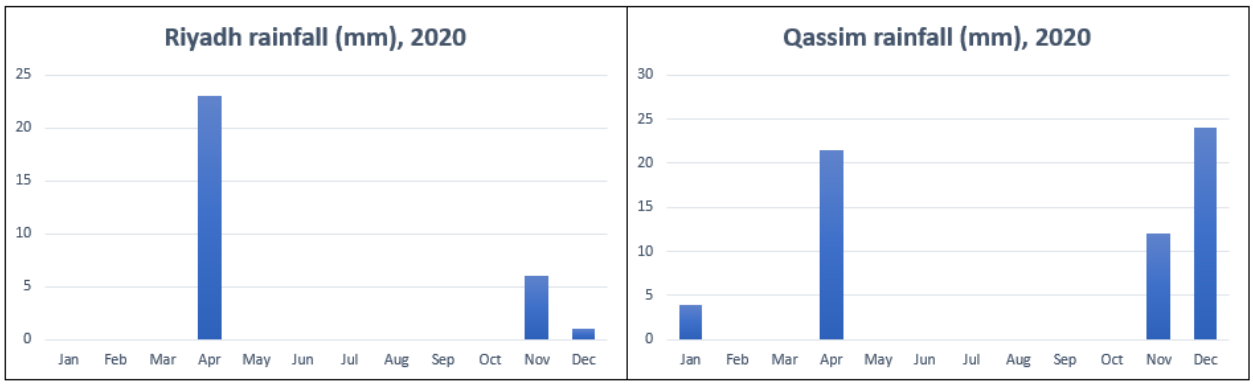
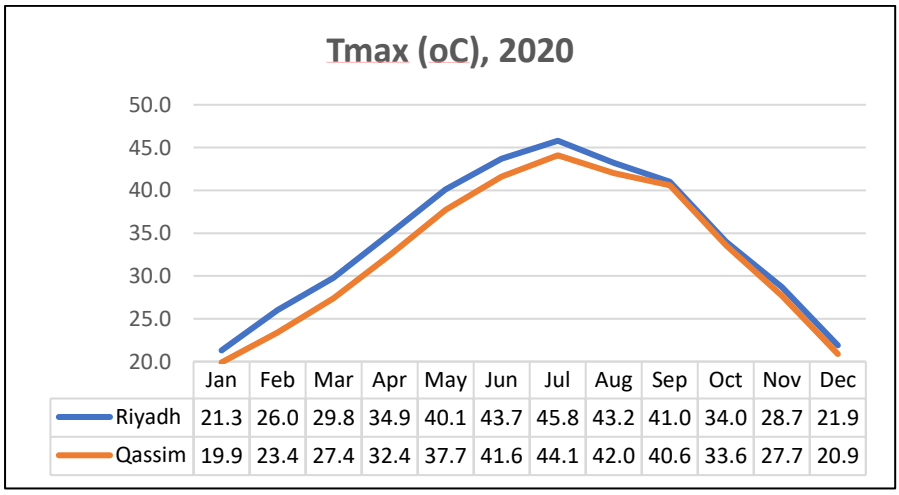


Figure 2. Rainfall distribution in Riyadh and Qassim in 2020 (Source: MEWA, 2020)

Wheat is a temperate crop and cannot tolerate temperatures above 35°C. The air temperature variation in central regions of Riyadh and Qassim leaves relatively short window for wheat cultivation (Figure 3). If planting is timed to the rains in November and December, the crop can comfortably grow and develop in January and February. However, starting from second part of March the high temperatures force wheat maturity making it ready for harvest in April. Winter and spring conditions in Qassim are better suited for wheat due to 1.5-2.5°C lower monthly average maximum temperature. Low temperature and even light frosts in January-February may result in wheat damage if it coincides with booting or flowering stage. For this reason, the farmers plant crop earlier than end of November to avoid the possibility of low temperature damage. All wheats grown in central regions are biologically spring growth habit as they do not require exposure to prolonged period of low temperature as a condition for development.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Riyadh	21.3	26.0	29.8	34.9	40.1	43.7	45.8	43.2	41.0	34.0	28.7	21.9
Qassim	19.9	23.4	27.4	32.4	37.7	41.6	44.1	42.0	40.6	33.6	27.7	20.9

Figure 3. Maximum average monthly temperature (°C) in Riyadh and Qassim in 2020 (Source: MEWA, 2020).

The modern GIS technologies and tools allow clear delineation of the crops growing environments. The study on documentation and characterization of the currently grown rainfed wheat areas and their potential for expansion is well justified.

4. CURRENT PRODUCTION PRACTICES

The production practices description is based on visual evaluation, informal and formal interviews and group discussion involving MEWA staff and farmers during the mission to the target governorates. The key steps of production process are documented below:

- Land allocation. The land allocated for rainfed farming is primarily under MEWA control and cannot be used for other purposes. In some cases, whole area is fenced protecting it from grazing. Prior to planting season, MEWA divides and allocates land to farmers to work and conduct all cropping activities.
- Cropping seasons. Rainfed wheat is not grown annually and if rainfall is not sufficient – one season can be skipped. In Az Zulfi governorate no wheat was planted this season due to lack of rain in November-December. Planting decision is made based on the amount of rain some farmers suggesting that rainfall water depth need to be at least 10 cm after rain to ensure sufficient moisture for the crop. It is unlikely that rain will support crop during the season. General such wheat production system is called "residual moisture crop" meaning that biomass and grain yield are formed using the moisture accumulated in the soil prior to planting. Similar wheat production systems are present in parts of India (Rajasthan), South Africa and Australia. These countries are potential sources of experience, varieties, and technologies for rainfed regions of KSA.
- Crop rotation. Only one crop is grown during the winter season, and nothing is grown in summer due to lack of moisture and high temperatures. The farmers may plant on the same field after previous wheat or can rotate to other fields not used previous season if available.
- Crop and variety choice. Barley is grown on approximately 5-10% of the area, however, its use is limited, and it also makes mixtures in wheat fields due to volunteers. Some farmer groups agree not to plant barley. Generally, barley is more drought tolerant compared to wheat. Millet is the most drought tolerant among cereals and grown on a small scale in some areas. Among wheat varieties grown there are two types: improved – Westbred and Yecora Rojo; landraces – several were mentioned and Maya-Halba seemed to be more popular in the regions visited. Wheat varieties are taken from irrigated areas where there is sufficient quantity of grain and seeds. This results in growing poorly adapted varieties. Selection of suitable crops and varieties is a challenge as it requires systematic work on development or importation of drought tolerant crops and varieties and their testing under field conditions, followed by selection, validation, multiplication, and promotion.
- Seed system. Rainfed farmers use their own seeds though some undertake special efforts in cleaning, sorting and storing the seeds destined for use next season. Seed viability and damage by pests may be an issue especially when they are stored for almost two years. The farmers indicated that they use a weed plant from the fields to put aside sacks of grain and it protects them from pest damage. There is a possibility that seed moisture is very low which makes their viability lasting. The seed system is an important challenge both in terms of producing quality seed material and seed storage.
- Soil preparation and planting. The advantage of rainfed wheat system is limited soil tillage. Normally the farmers would wait for rain and after soil is sufficiently dry to enter the field – they conduct planting using fertilizer broadcaster. After broadcasting, a cultivator is used to incorporate the seeds. The cultivator makes shallow ridges on top of the soils though it does not place the seeds in rows. The seeds rate is 180-200 kg/ha though normally dryland wheat production requires substantially less seeds.
- In-season activities. The farmers normally do not conduct any activities during the season: no fertilizers, crop protection or weeding. The rainfed and irrigated wheat fields visited were relatively free from weeds without diseases and insect pests except observation of loose smut on a single field.
- Harvesting. Conducted using rented combine harvester services (200SAR per hour). The technical challenge is harvesting drought stressed crop with short height of 30-40 cm. Sometimes the field can be abandoned due to short height of the crop and low yield. Generally, average yield of rainfed wheat is 1.5 t/ha varying from total failure to 4 t/ha in good year.

5. RESEARCH, EXTENSION, POST-HARVEST, PROCESSING AND VALUE ADDITION

The interviews and discussions with the rainfed wheat farmers proved that there is no systematic access to research and extension products. National Organic Research Center in Qassim does not have cereals

or wheat in its research agenda. Its activities are limited to multiplication of wheat landrace, barley, and triticale on its experimental station. The Seed Center at Riyadh conducted collection of wheat varieties and landraces across all production regions and has been testing and selecting superior material. However, it is mostly irrigated type. The Agriculture Department of Qassim University has experimental station in Buraydah but the activities on rainfed wheat are not clear. At least, there is no dedicated rainfed station or experimental field which can confidently conduct experiments of crops, varieties, and agronomic practices.

Very little grain produced on rainfed wheat fields is traded – around 10-20%. It is mainly used for household consumption and preparation of local dishes like marquq, qursan and musabeeb. The grain is stored in sacks and milled in small mills when needed. The price of grain is high and can reach 6SAR per kg. The value addition is limited to flour milling and baking local products to sell directly to consumers or through the markets and shops.

Wheat straw is value forage for camels and other livestock and in some years may bring ash comparable to grain. It is normally bailed and stored on-farm or sold.

6. IRRIGATED WHEAT PRODUCTION PRACTICES AND RELATIONS TO RAINFED WHEAT

Rainfed and irrigated wheat production are closely related being implemented in geographically close area, sometimes by the same farmers. The commonality between the rainfed and irrigated farmers are the following:

- Seeds exchange from irrigated to rainfed areas and sometimes opposite direction.
- Use of the same varieties through landraces perform better under rainfed conditions.
- Common use of broadcasting followed by cultivation for planting. Some farmers start their wheat crop after rainfall with the hope that it can be sustained on residual moisture. However, if the crop suffers from moisture stress, the rainfed farmers would use supplementary irrigation for their crop.
- Harvesting and straw bailing are similar but irrigated wheat farmers sell most of their grain unlike rainfed farmers keeping it.

Irrigated wheat production has specific features and challenges not observed and not so common on rainfed wheat:

- High and excessive use of irrigation water.
- Soil salinity originating from saline irrigation water and well as from excessive irrigation.
- Higher population and crop damage from weeds.
- Use of organic or mineral fertilizers.
- The growing cycle of irrigated wheat is longer, and its terminal stages are subject to high temperature stress.
- Marketing the grain and generation of profit plays more importance in irrigated wheat compared to rainfed.

Though only few irrigated wheat fields were visited during the mission. Wheat crop appeared stressed most likely due to salinity or high temperature or both. The height did not exceed 60-70 cm. Due to interrelation of irrigated and rainfed wheat, the potential interventions may include both crops.

7. SUMMARY, CHALLENGES AND FUTURE ACTIONS

The current situation analysis and mission covered only 20-30% of the target rainfed wheat production area identified by MEWA. Therefore, the results of the analysis shall be considered as preliminary and more thorough evaluation need to take place. The main characteristics of rainfed wheat sector are the following:

- The area under rainfed wheat is relatively small with around 6,000 ha, normally utilizing public land provided to farmers to grow wheat.
- The production depends on residual soil moisture after the rainfall in November-December and on average the crop fails or provide poor yield two years out of five.
- Production practices are low input with minimal operations to plant and harvest.
- Though the sector is small it is important as its sustainability and dependence on renewable water resources is high and it involves a number of farmers and households contributing to rural development.

The study identified the main challenges faced by rainfed wheat production sector:

- ✓ Planting by broadcasting followed by cultivation results in shallow seed placement which does not allow good root development which is critical under dryland condition. Deep planting up to 6-8 cm using drills designed for zero tillage will improve plants establishment and grain yield.
- ✓ Overall lack of machinery and equipment for rainfed wheat production including planters, cultivators, combine harvesters, seed cleaners, pre-planting seed dressers, grain and seeds storage facilities.
- ✓ Wheat as the only crop targeted for rainfed production may be diversified by using more drought tolerant crops like barley, millet, sesame, or cactus (Opuntia spp) which can be used to improve degraded land and can be intercropped with cereals.
- ✓ Inappropriate varieties frequently taken from irrigated fields and hardly suitable for residual moisture conditions.
- ✓ Lack of research and extension specifically targeting rainfed wheat production. This is probably also true for irrigated wheat.
- ✓ Farmers capacity on dealing with rainfed wheat production can be improved through systematic targeted training.

The current situation analysis proposes the following actions:

I. Conduct GIS study to delineate the potential areas of rainfed crops production in central and northern regions including Riyadh, Qassim, Hail and Al Jouf. The study may also identify similar regions worldwide which can be benchmarked for rainfed crops productions.

II. Address the immediate needs of the farmers by provision of machinery and equipment including tractors, zero tillage planters, cultivators, combine harvesters, seed processing equipment and storage facilities. Some rainfed areas are operated by groups of farmers which can establish cooperatives which will operate the machinery and equipment.

III. Develop a project on adaptive on-station and on-farm research targeting rainfed crops and varieties evaluation, improved technologies, and practices including water catchment and use. This can be done through MEWA or Universities research establishments located in the target regions.

IV. Overall larger project on wheat production for both irrigated and rainfed environments is well justified to assess the current practices, develop, and implement improvement interventions. Justification of such project comes from the importance of wheat for food security and its potential for improvement under irrigated conditions to optimize varieties, technologies, reduce the impact of salinity and reduce irrigated water usage.

V. Establish experimental rainfed demonstration farms in the key governorates practicing rainfed wheat production, which should include diversification focusing on soil health restoration.

8. REFERENCES

Kucera Paul A., Duncan Axisa, Roelof P. Burger, Don R. Collins, Runjun Li, Michael Chapman, Rafael Posada, Terry W. Krauss, and Ayman S. Ghulam (2010) Features of the Weather Modification

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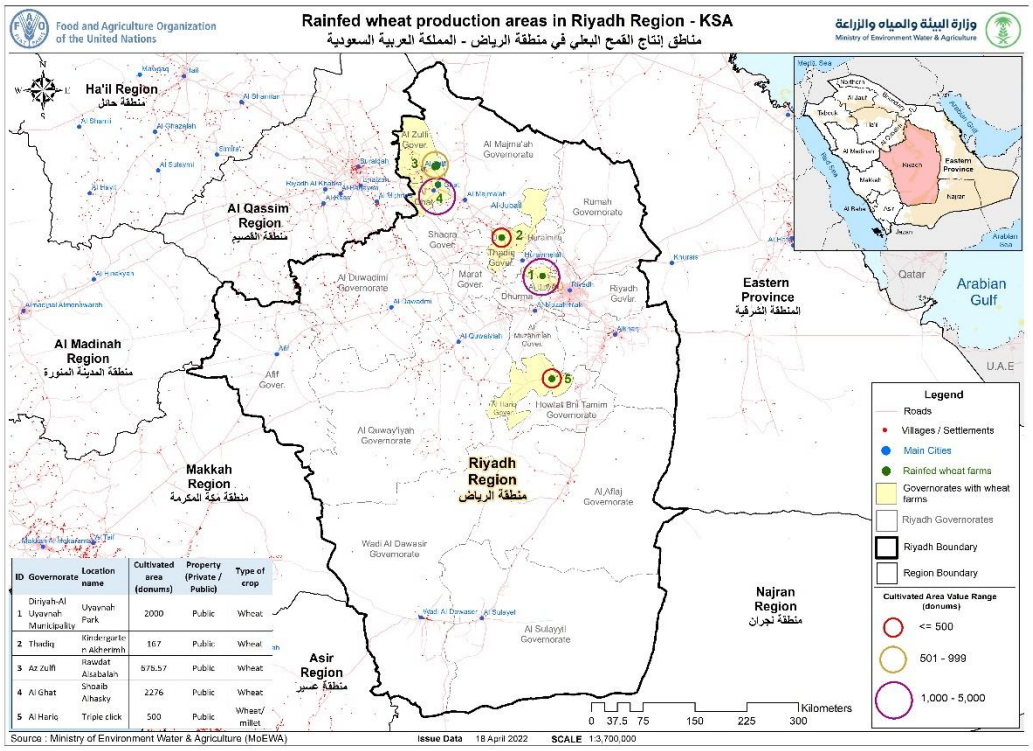
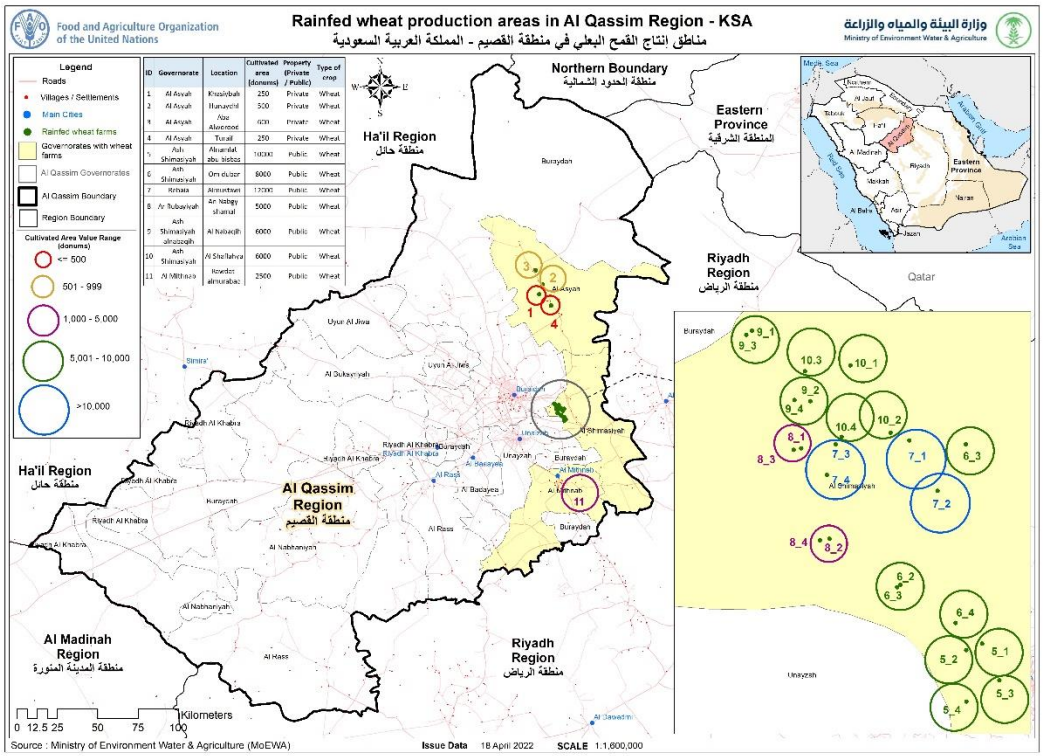
ANNEX 1

Maps of Riyadh and Qassim rainfed wheat production areas.





ANNEX 2

Photos of rainfed wheat cultivation in Riyadh and Qassim regions.

Photo 1: A field of rainfed wheat in Al Zulfi north of Riyadh region after harvesting

Photo 2: Another wheat rainfed field in Ash Shmasyia in Qassim region showing weak growth because of lack of rain.

برنامج التعاون الفني بين وزارة البيئة والمياه والزراعة ومنظمة الأغذية
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