Definitions Document

1.0 Background

Key to effective mapping is to have a precise and clear definition of what is mapped. It is the first and primary step. For example, irrigated areas are defined and understood differently in different applications and contexts. One can define them as areas which receive irrigation at least once during their crop growing period. Alternatively, they can be defined as areas which receive irrigation to meet at least half their crop water requirements during the growing season. One other definition can be that these are areas that are irrigated throughout the growing season. In each of these cases, the irrigated area extent mapped will vary. Similarly, croplands can be defined as all agricultural areas irrespective of type of crops grown or they may be limited to food crops (and not the fodder crops or plantation crops). So, it is obvious that having a clear understanding of the definitions of what we map is extremely important for the integrity of the products developed. In this project we define cropland products as:

1.1 Croplands:

All cultivated plants harvested for food, feed, and fiber, including plantations (e.g., orchards, vineyards, coffee, tea, rubber)**.**

1.2 Minimum mapping unit

The minimum mapping unit of a particular crop is an area of 3 by 3 (0.81 hectares) Landsat pixels identified as having the same crop type.

1.3 Cropland extent

All cultivated plants harvested for food, feed, and fiber, including plantations (e.g., orchards, vineyards, coffee, tea, rubber).

1.4 What is a cropland pixel?

>50% of pixel is cropped

1.5 Irrigated areas

Irrigation is defined as artificial application of any amount of water to overcome crop water stress. Irrigated areas are those areas which are irrigated one or more times during crop growing season.

1.6 Rainfed areas

Areas that have no irrigation whatsoever and are precipitation dependent.

1.7 Cropping intensity

Number of cropping cycles within a 12 month period.

1.8 Crop type

Crops (Wheat, Corn, Rice, Barley, Soybeans, Pulses, Cotton, Potatoes)

1.9 How are croplands mapped in this project? Or what cropland products are produced in this project?

The overarching goal of this project is to produce consistent and unbiased estimates of global agricultural cropland areas, crop types, crop watering method, and cropping intensities using mature cropland mapping algorithms (CMAs) @ nominal 1 km, 250m, and 30m. Specific products produced are (Figure 1):
Product 1: Cropland extent\area,
Product 2: Crop types (focus on 8 crops that occupy 70% of global croplands),
Product 3: Irrigated vs. rainfed croplands,
Product 4: Cropping intensities\phenology (single, double, triple, continuous cropping),
Product 5: Change over time and space..

1.10 Net cropland areas by country
Refers to actual cropland area whether the cropland is cropped or left fallow. It does not account for cropping intensity. However, it does include permanent crops (e.g., plantations)

1.11 Gross cropland area by country
This includes cropping intensity. It is harvested area during various seasons (e.g., single, double, triple cropping in a season). It also includes permanent crops.

1.12 Net rainfed cropland area by country
An cropland area is considered rainfed when it is not irrigated in any one season and is purely dependent on rains. Refers to actual cropland area in a country whether the cropland is cropped or left fallow. It does not account for cropping intensity. However, it does include permanent crops (e.g., plantations).

1.13 Gross rainfed cropland by country
An cropland area is considered rainfed when it is not irrigated in any one season and is purely dependent on rains. This includes cropping intensity. It is net harvested area during various seasons (e.g., single, double, triple cropping in a season). It also includes permanent crops.

1.14 Net irrigated area by country
A cropland area is considered irrigated when artificial water is applied to crops from whatever source (e.g., river, lake, wells) during any one of the cropping seasons. If the crop is irrigated during one season, but is not during another season, it is still considered irrigated area. Also, number of irrigation does not matter. Even a single irrigation during the cropping seasons, still makes it an irrigated area, Net irrigated area refers to actual irrigated cropland area whether the irrigated cropland is cropped or left fallow. It does not account for cropping intensity. However, it does include permanent crops (e.g., plantations) when irrigated.

1.15 Gross irrigated area by country
A cropland area is considered irrigated when artificial water is applied to crops from whatever source (e.g., river, lake, wells) during any one of the cropping seasons. If the crop is irrigated during one season, but is not during another season, it is still considered irrigated area. Also, number of irrigation does not matter. Even a single irrigation during the cropping seasons, still makes it an irrigated area, this includes cropping intensity. It is harvested area during various seasons (e.g., single, double, triple cropping in a season) in the area that is defined irrigated. It also includes permanent crops when irrigated.

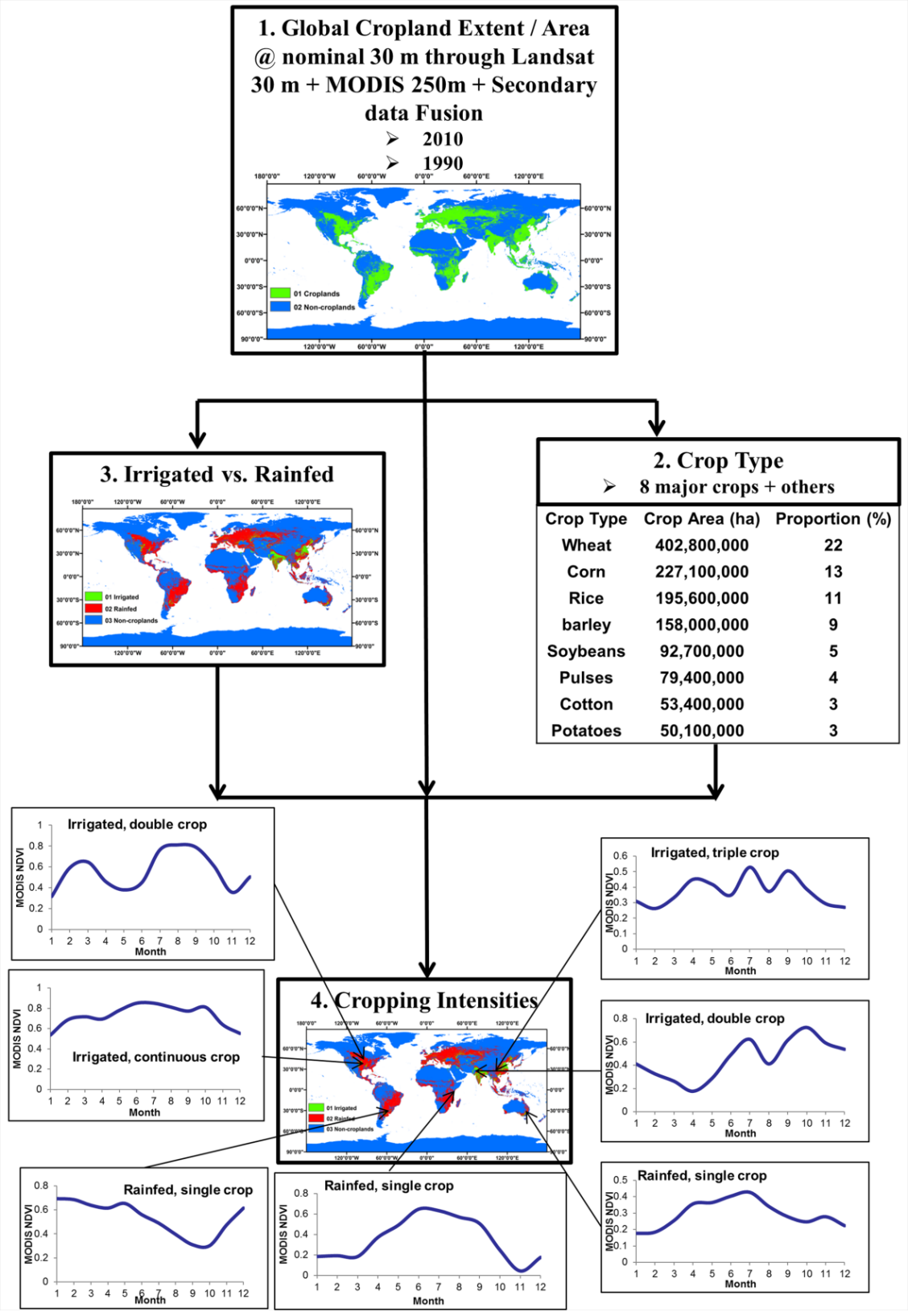

Figure 1. Four products produced by this project.

Questions and Answers:

A. **Is pasture included in cropland extent mapping? If it is included, how is pasture defined? Should it be an independent class separated from the "cropland" class? What type of pasture should be included, cultivated and/or wild growing?**

Answer: Pasture is NOT included in croplands mapped in this project. In entire world roughly 1/3rd of terrestrial area is under croplands + rangelands (that include pasture). Of the 12% under croplands [All cultivated plants harvested for food, feed, and fiber, including plantations (e.g., orchards, vineyards, coffee, tea, rubber)]. The rest 24% is under rangelands (e.g., grasses\pasture, shrubs). So, in your mapping do not worry about pasture. What you should map is all croplands (again for emphasis: All cultivated plants harvested for food, feed, and fiber, including plantations (e.g., orchards, vineyards, coffee, tea, rubber). Fallow croplands (areas equipped for croplands, but are not cultivated in certain season or year, are also croplands; but of separate class called cropland fallows.

B. **Should abandoned agriculture land resulting from agriculture shift be included? After how many years without plantation should a land be defined as "abandoned"? How about fallow land? Should it be included and how is it defined?**

Answer: Abandoned croplands should be classified as cropland fallows. There are following types of cropland fallows (abandoned croplands for convenience):

- Cropland fallows that are seasonally abandoned (e.g., you do cultivate crops in one season, but not in another; or you cultivate crop in two season but not in other).
- Cropland fallows that are abandoned for 1 or more years (e.g., you call these 1 year fallow, 1-3 year fallow, 3-5 year fallow, >5 year fallow)
- Shifting cultivation (e.g., slash and burn agriculture that again turn up into 1 year fallow, 1-3 year fallow, 3-5 year fallow, >5 year fallow)

The question is how do you map cropland fallows?. When they are seasonally (e.g., any one growing season) left fallow, they often appear as barren farms (Note: e.g., these are farms that are equipped for cropping, but nothing growing during a season). These will have very low NDVI throughout the season. Then, the cropland fallows (e.g., 1 year fallow, 1-3 year fallow and so on). These are croplands which are abandoned for various periods and natural vegetation re-emerges. These are mapped by looking at multi-year data (e.g., cropped in year 1, but abandoned in year 2 where there is fallow vegetation growing and various other scenarios).

Overall, if you have a single class called cropland fallows, which will suffice. Then we can look through years (using multi-temporal data) and see in which year it is cropped and which year it is fallow. Also, don't forget that crops that are grown during single season, are left fallow in another season (e.g., in Mid West USA you have crops in summer and no crop in winter).

C. **Should other types of plantation, such as orchard, coffee, cocoa, rubber, etc., be included? And how about timberland?**

Answer: These crops come under the class called: "Continuous cropping". Means, crops are on farmland throughout the year. All plantation crops (e.g., coffee, tea, rubber, and at times other crops like sugarcane) come under this category.

Overall, we have four clear crop products (Figure 1):

- Croplands or non-croplands
- Irrigated or rainfed
- single crop, double crops, triple crops, continuous crop
- crop type: any major crop you can map (we have identified 8 leading crops of the world)