Editorial

Cropping pattern design: the steps and considerations

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Volume 4 Issue 5 - 2016

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Received: September 25, 2016 | **Published:** September 26, 2016

To attain sustainability, we are forced to select the best options to direct all systems toward the highest resource use efficiency. Indeed, nowadays we cannot write or suppose a unique prescription for all the farms throughout the world. Undoubtedly, selecting proper cropping patterns is ineligible to achieve the goal. Sometimes, when we talk about cropping patterns, we imagine rotation is the case, while the rotation is the final step of a cropping pattern design. For a successful cropping pattern design (CPD) the aim of designing should be clear. Undoubtedly, for a reasonable CPD, we should consider the most important limiting factor(s). For example, if water deficiency is the main concern in a given region, the system with the highest water use efficiency along with reasonable economic return should be considered as the best cropping pattern. This may be based on labor availability, land limitation and so on. A good cropping pattern should be matched with farmer's capabilities regarding to their facilities, machinery, farm size, social conditions and even political constraints. For example, it should consider the employment of the farmer's family in the agriculture section to prevent inverse emigration from the rural communities toward the cities or the labor requirement should be distributed during each year to provide the job for rural communities. These are important notes that a designer should be considered in the final plan. Each CPD has five consecutive steps to be planned (Figure 1). In the first step, the patterns should be suggested. In this step, we make decisions about the type and the sharing ratio of each crop to occupy the farm. It is clear that return period of the crops to rotation should be considered. For example, cereals could not occupy more than 25% of the land, because their return period to each land unit management (LUM) should not be less than three or four years. This means that, each LUM should be cultivated by a cereal crop every four years. The reasons are obvious: Prevalence of diseases and pests, weeds seed bank improvement, and possible allelopathic effects.

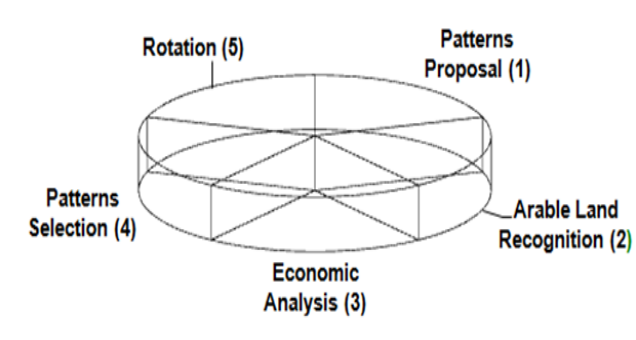

Figure 1 Five consecutive steps of a cropping pattern design for water-limited areas.

After selecting crops and the share of each crop, many combinations of different crops and the share of each crop to occupy LUMs are suggested. Then, fallow area is determined. Therefore, in the second step, the crop water requirement for each crop during its growing season and depending on the varieties are cultivated, would be determined. This is done based on water balance theory in agro ecosystems and recorded meteorological data as long time-series data. Fallow area (or possible arable lands) will be determined by calculating the volume of available water from seasonal and permanent water resources such as rivers, springs, and etc. In the second stage, data of two previous steps are combined to calculate the water requirement of each suggested cropping pattern. In the third stage, net income of each cropping pattern will calculate based on the reference yield of each crop (Normally long-term averaged yield for the given area). Net income will be calculated by gross income minus the production costs.

In the fourth step, the most proper pattern will be selected based on the aim of the project. For example, for a project with the aim of increasing water use efficiency, the suitable cropping pattern will have a high water use efficiency and a reasonable economic return. Finally, in the fifth stage, the selected cropping pattern will be used to design the rotation. As you know, rotation planning is a complicated process with a lot of considerations that are not the scope of this article. The rotation planning also has many steps, including determining the LUMs size, quality, and constraints to grow the crops of selected cropping pattern for the first year, and the constraints of continuing the rotation in the next years (at least 10years). Nowadays, mathematical matrices are used to plant the rotation in consecutive years for the same LUMs. When the long-term plan of rotation was provided, cropping pattern design is finished. All mentioned steps, need a scientific base and sometimes a strong team working to guarantee the end result of the project. Because, CPD is done for large-scale projects, the designers must also be careful even about minor mistakes in calculations and making decisions.

It should be mentioned that, new technologies such as remote sensing and geographical information system also could help us to have a more reliable planning, especially for detecting constraints and determination of land unit managements. Incorporating the calculation-based methods with remotely-sensed data could help designers to present the plans for the small-scale projects too. Moving toward sustainability of agro ecosystems will not be attainable, unless all the lands to be considered as important LUMs.

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.

Citation: Kamkar B. Cropping pattern design: the steps and considerations. *Adv Plants Agric Res.* 2016;4(5):368–369. DOI: 10.15406/apar.2016.04.00152