# The economic sustainability of cropping systems in Indian Punjab: A farmers' perspective

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**Abstract**

Punjab, a small northern Indian state has developed, particularly since the Green Revolution in the mid 1960s, to be a key agricultural area producing 13% of the food grains of India. Increased productivity brought economic benefits to farmers and led to the establishment of Wheat-Rice Cropping Pattern (WRCP) as the main agricultural system of Punjab which more recently has become reliant on underground water resources, agricultural machinery, chemical fertilisers and pesticides. However, the WRCP has been, and remains the first choice of farmers. This paper compares the economic sustainability of WRCP to that of other alternative cropping patterns in Punjab and answers the question "Why farmers continue with the WRCP despite various crop diversification efforts in the past". Interviews with 120 farmers across Punjab illustrated the economic and risk advantages of WRCP over other potential cropping patterns and concludes that if cropping systems in Punjab are to become more environmentally sustainable then policy makers will need to put mechanisms in place which either encourage a more sustainable WRCP or provide the basis for the growth of alternative, less environmentally damaging cropping systems.

**Keywords:** agriculture, cropping systems, Punjab, sustainability

## Background

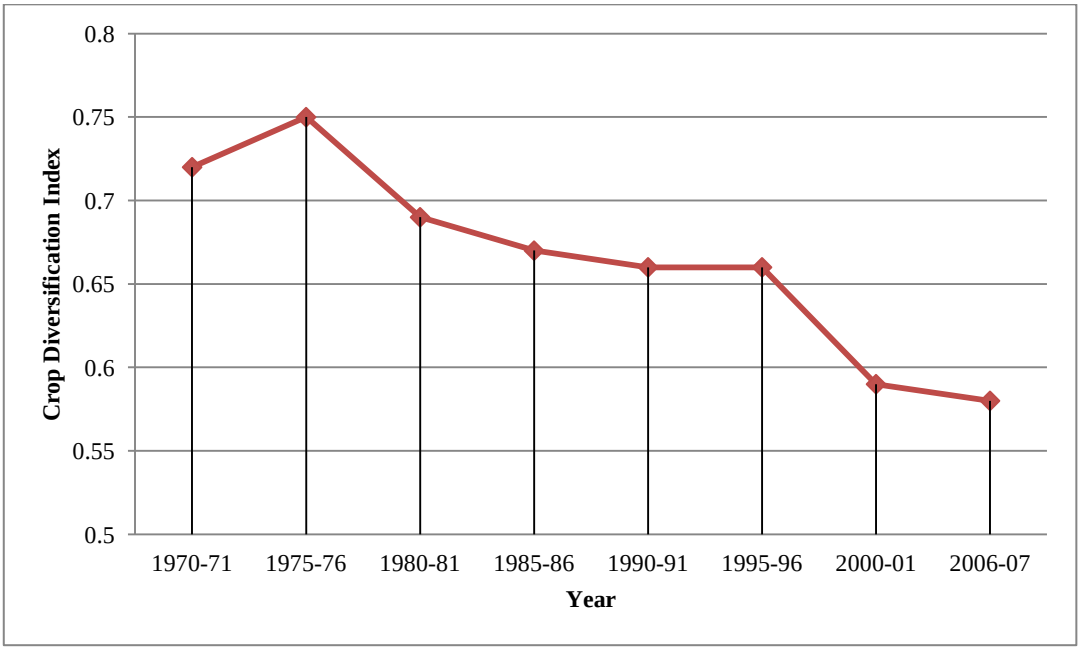
The Indian Punjab, a small state (latitude: 30° 4' N; longitude: 75° 5' E) occupying 1.53% of geographical area of the country produces about 20% of wheat and 11% of rice production of India (IFPRI, 2007; World Bank, 2003). The state economy grew at a much faster rate (6 to 7% per annum) during 1970-80 compared with 3 to 4% at national level but it slowed down (3 to 4% per annum) after mid 1980s compared with 8 to 9% at national level (World Bank, 2003). Agriculture is a key element of the Punjab economy as it contributes around 40% to Punjab's GSDP (Gross State Domestic Product) compared to around 20% at national level (IFPRI, 2007). Agriculture in Punjab, having the highest yields of wheat and rice in India with a cropping intensity[1] of 189% compared with 135% at India level, is highly mechanized with 97% irrigated land (40% at India level) and 106 tractors per thousand hectares (only 22 per thousand hectares at India level) (IFPRI, 2007).

Punjab's agricultural development is one of the success stories of the Green Revolution strategy, an Integrated Agricultural Districts Program (IADP) launched by the Indian government in the mid 1960s to overcome the food shortages born out of two consecutive droughts in 1964-65 and 1965-66 and two unanticipated wars with China and Pakistan in 1962 and 1965 respectively

[1] If one crop is sown on a given area in a year the cropping intensity is 100%. If two crops are grown, this rises to 200%.

(Sidhu, 2002). This intensive agricultural development program not only helped India achieve food self-sufficiency but also brought rich economic benefits to Punjabi farmers enabling them to build up a modern agricultural infrastructure and subsequently helped Punjab reduce rural poverty from 28.2% in 1972-73 to 6.4% in 1999-00 (Sidhu et al., 2010; World Bank, 2003). Undoubtedly, the Green Revolution helped the Punjab convert into one of the most highly mechanized agricultural states of India. However, it can be viewed as a mixed blessing for Punjab because it led to the establishment of Wheat-Rice-Cropping-Pattern (WRCP) as a main cropping pattern in many parts of Punjab by eliminating all the other available cropping patterns during the pre Green Revolution period (World Bank, 2003). The WRCP has been, and remains, the most preferred cropping pattern across Punjab due to its comparative economic advantages, assured marketing and stable productivity levels (Sidhu et al., 2010; World Bank, 2003). As a result, WRCP continues to occupy more than 77% of net cropped area of Punjab (GoPb, 2009) which has further dropped the crop diversification[2] index from 0.75 in 1975-76 to 0.58 in 2006-07 (Figure 1).

**Figure 1: Trends in crop diversification in Punjab between 1970-71 and 2006-07**




Source: Sidhu et al., 2010

[2] The crop diversification index, calculated as DI= 1-H, where H is Hirschman-Herfindahl Index, measured by $\sum (P_{it} / \sum P_{it})^2$, P it being the value of production at 2001-02 prices of the i-th crop in year t. A higher DI indicates greater crop diversity in production patterns.

**Sustainability of WRCP**

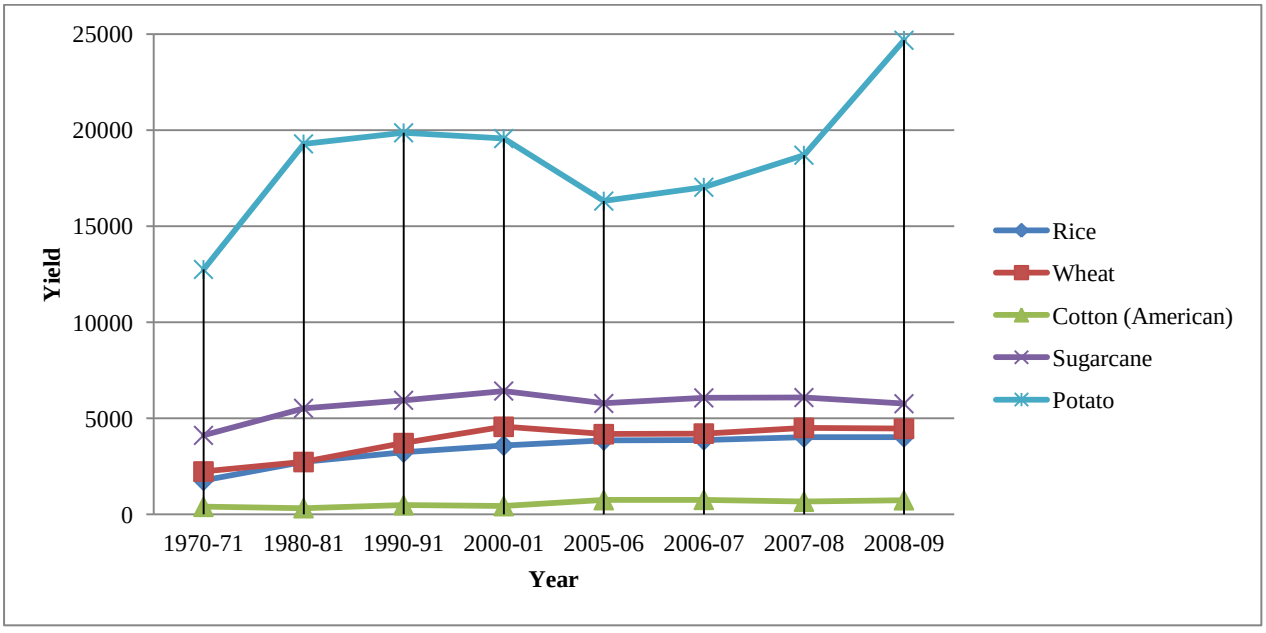
It has been suggested (Chand, 1999) that Punjab's agricultural production system could be successfully replicated in the other parts of the country or world like Sub-Saharan Africa. This assertion may have led to benefits in the initial days of the Green Revolution but the current situation is less convincing in relation to sustainability because of the sharp decline in net farm profitability related to increases in the cost of cultivation and continuous degradation of natural resources notably underground water and soil (Chand, 1999, Sidhu, 2002; Singh, 2004; Sidhu et al., 2010). Recent data collected by the Department of Agriculture (Government of Punjab) shows, despite having good rains in 2010, that the water table across the state has further decreased (Singh, 2011). The major rice growing districts of Moga, Sangrur, Barnala and Ludhiana have registered a fall in the water table of 1.75 meters, 1.50 meters, 1.25 meters and 84 cm respectively from June 2009 to June 2010. On the other hand some districts, where the rice cultivation is less intense like Patiala, Ropar and Nawasheher, have witnessed a two-meter increase in water table during the same period (Singh, 2011). This can lead to water logging and a subsequent loss of productivity. In fact, Punjab canals have only 14.54 Million Acre Feet (MAF) of water against an estimated need of 52 MAF. The gap of 38 MAF is met through tube wells leading to over-exploitation of underground water resources (Singh, 2011). Unfortunately, the fall in the water table in central zone and its rise in the other areas, have hit the farm economy severely.

With a sharp decline in crop diversification index from 0.75 to 0.58 (Figure 1) in the last four decades, Punjab has developed a culture of mono-cropping, a major cause of degradation of soil health across Punjab (Singh et al., 1997; Sidhu and Johl, 2002). Loss of Organic Carbon Matter (OCM), deficiency of macro as well as micro nutrients such as nitrogen, phosphorus, sulphur, zinc, iron and manganese in the Punjab soils have been reported (PAU, 2007). On the contrary, Benby et al. (2009) argue that the soil health has improved across the state over the last 40 years because the pH value is well-suited to crop production (6.5 - 7.5) and OCM has improved in Punjab soils as a result of decomposition of more crop roots under the soil due to the intensive agriculture since the mid 1960s. However, the stagnation of crop yield and increase in the amount of chemical fertilizers required to maintain productivity suggest a gradual degradation of soil resources. This stagnation in yield rates compels the farmers to use more chemical fertilizers and pesticides to match the productivity levels. Pesticide usage has increased from 3200 kg $ha^{-1}$ of technical grade in 1980-81 to 5760 kg $ha^{-1}$ of technical grade in 2008-09, an increase of 44% in 30 years (GoPb, 2009). These increases related to higher levels of pest attack which are thought to relate to rises in humidity level in the recent years (Sidhu et al., 2010). Figure 2 illustrates that despite the increase in the use of chemical fertilizers and pesticides, the yield rates of major crops

like wheat, rice, cotton, and sugarcane have stagnated which has directly hit the net farm profitability. However, it can be noted that the yields of wheat and rice have been quite stable which may be linked to probability of low risk in WRCP.

Punjab, which was once a showpiece of excellent agricultural development at the national level, has now turned into a case of waste and inefficiency (Shergill and Singh, 1995; Sidhu and Dhillon, 1997; Aulakh and Bahl, 2001). Therefore, the sustainability of current agricultural cropping system has been under question since 1990s. For instance in late 1998, a group comprising eminent agricultural experts and government officials analyzed "the condition of farms and farmers in Punjab" and formulated a long-term strategy to avoid a socio-economic crisis in Punjabi agriculture (Chand, 1999). To overcome this crisis, they suggested that the farmers should diversify from wheat and rice to vegetables, fruits, and dairying but little has happened in the intervening period. In 1986 and 2002, Johl committees (GoPb, 1986, 2002) suggested diversification of about 30% of net cropped area from wheat and rice to other high value crops. Efforts continue to convince farmers to diversify from WRCP to tomato, potato and citrus cultivation through cooperative or contract farming.

**Figure 2: Trends in yield rates (kgs / ha) of major crops in Punjab between 1970-71 and 2008-09**




Source: Calculated from various issues of the Statistical Abstract of Punjab

Despite this farmers have not reduced the area under wheat and rice (Table 1) because of its comparative economic advantage, assured marketing (95% of wheat and rice that comes in the market is bought by central government) and stable productivity level (World Bank, 2003). Yield

rates of rice, which is considered as the main culprit for decline of underground water table, never came down largely in the past four decades whereas cotton, sugarcane and potato, the potential substitutes of rice, have never been to demonstrate such stability in terms of yield and procurement prices (Figure 2 and Table 1).

More importantly, the procurement prices of wheat and rice rose with 89 and 88% growth respectively between 1980-81 and 2008-09 whereas in case of other crops such as cotton, sugarcane and potato prices remained unstable (Table 1). Assured purchase of wheat and rice at Minimum Support Prices (MSP) by the central government for its Public Distribution System (PDS) makes WRCP an obvious choice for farmers in Punjab (Table 1). According to a report by World Bank (2003), MSPs of wheat and rice went up considerably, inconsistent to international prices, market prices, prices of other crops, or to inflation whereas their C2, cost of production which includes all actual expenses in cash and kind including rent paid for leased land, rental value of owned land, imputed value of family labour, and interest on value of owned capital, remained consistent around Rs 450 per quintal between 1990 and 2001. In Punjab, the average difference between MSP and C2 (cost of production) of wheat increased from 20% to 36% between 1981-89 and 1996-2000 and in case of rice it also increased from 14% to 26% during the same period which further allures the farmers to grow wheat and rice only and hinders the crop diversification drives run by the state government.

**Table 1: Procurement prices of major crops in Punjab (in Rs per 100 kg)**

| Year | Rice | Wheat | Cotton (American) | Sugarcane | Potato[3] |
|---|---|---|---|---|---|
| 1980-81 | 105 | 117 | 304 | 13 | Not Available |
| 1990-91 | 205 | 215 | 620 | 22 | 195 |
| 2000-01 | 510 | 580 | 1625 | 59.5 | 114 |
| 2005-06 | 620 | 850 | 1720 | 80.25 | 496 |
| 2007-08 | 745 | 1000 | 1800 | 81.18 | 600 |
| 2008-09 | 900 | 1080 | 2500 | 81.18 | 725 |

Chand (1999) also considered the issue of stability parameters in different crops and concluded that because of MSP (Minimum Support Price) regime, price instability is also lower in wheat and rice which makes them highly stable in terms of gross returns too (Table 2).

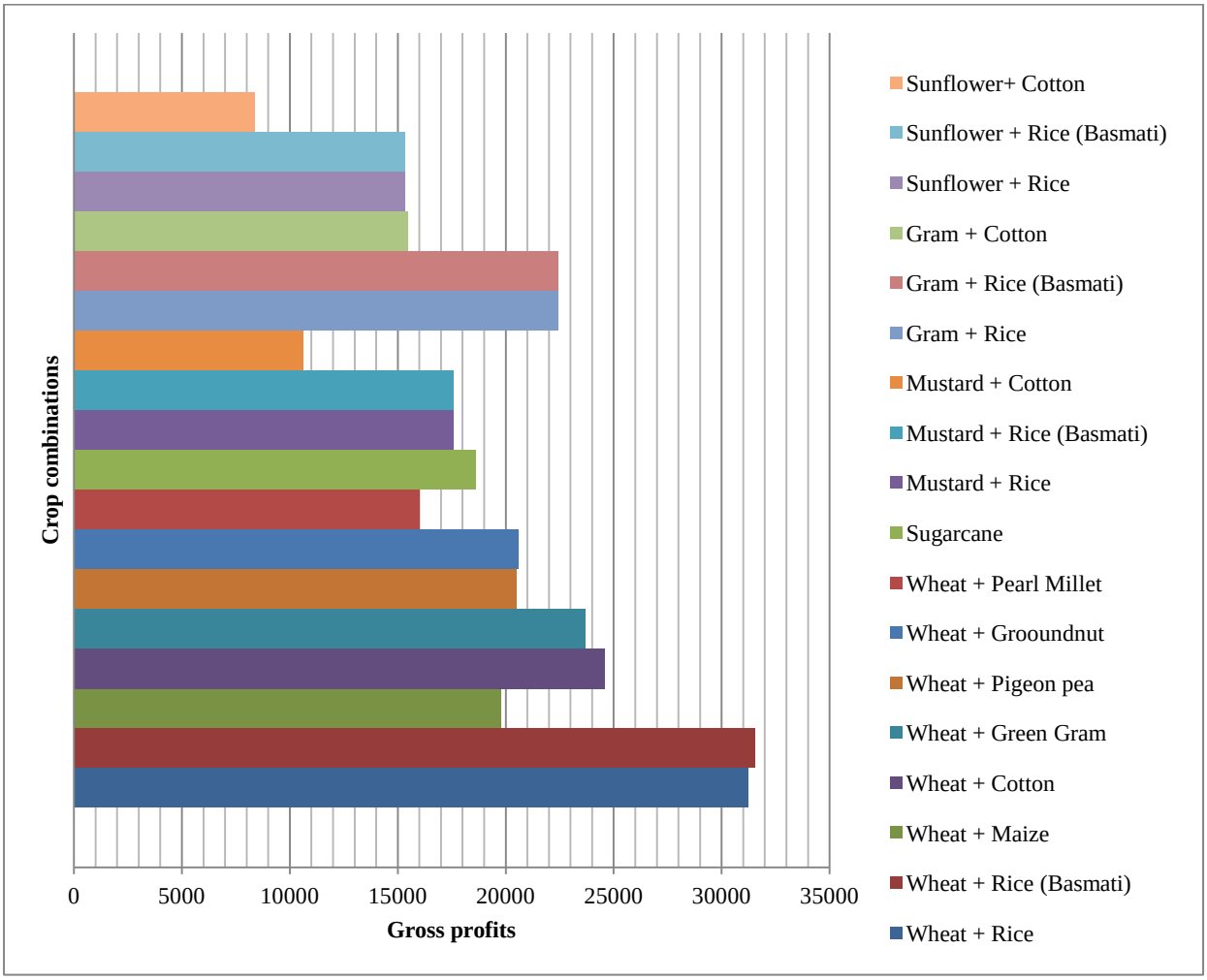
[3] The harvest prices of potato are taken since government does not fix its procurement price
Source: Calculated from various issues of Statistical Abstract of Punjab

**Table 2: Instability[4] of yield, gross returns and farm harvest prices of different crops in Punjab, 1972-73 to 1991-92**

| | Rice | Maize | Cotton | Wheat | Rapeseed/Mustard | Potato | Sugarcane |
|---|---|---|---|---|---|---|---|
| **Yield** | 10 | 20 | 26 | 7 | 7 | 21 | 27 |
| **Returns** | 19 | 33 | 41 | 10 | 29 | 44 | 40 |
| **Price** | 21 | 23 | 27 | 8 | 31 | 31 | 39 |

Source: Chand, 1999

**Figure 3: Gross profitability (in Rs / ha) from major crop combinations in Punjab in 2001-02**




Source: Calculated from data in World Bank report (2003), pp 28

Note: Sugarcane, being an annual crop is taken as a single crop

[4] Instability in the variable say (Y) is computed by taking standard deviations of [In (Y,/Y,1)], which shows average deviation from the trend line LnYt=b,+blT+e..

Additionally, the data (Figure 3) published in a report by the World Bank (2003) clearly exhibits that wheat and rice (Basmati) and wheat-rice give annual profits of Rs 31546 and Rs 31223 respectively whereas the other crop combinations fail to exceed Rs 25000.

High value crops suggested by proponents of crop diversification do not have a reliable market and have very high production risk (Chand, 1999; World Bank, 2003). Shergill (2007) argues that wheat-rice specialization has a sound economic footing under the current parameters and constraints in terms of food security. Regarding the research and development agenda, Punjab Agricultural University Ludhiana, a major agricultural research institution in Punjab, continued to increase its budget allocation for wheat and rice research from 16% to 20% between 1980 and 2001 (World Bank, 2003).

Overall we have presented a range of reasons for the popularity of the WRCP in Punjab as well as information which questions the sustainability of these systems. Data from a survey with farmers is now presented to determine why farmers continue with the WRCP despite the range of evidence questioning the sustainability of the system.

**Method**

In order to investigate the current situation, primary and secondary data was obtained. Most of the information on water and soil resource use is obtained from secondary sources. Primary data (both qualitative and quantitative) was collected from 120 farmer households spread across six villages in three districts, Gurdaspur (1), Barnala (2) and Ferozpur (3) representing sub-mountainous, central and south-western agro-climatic zone of Punjab respectively (Figure 4) during August and September 2010.

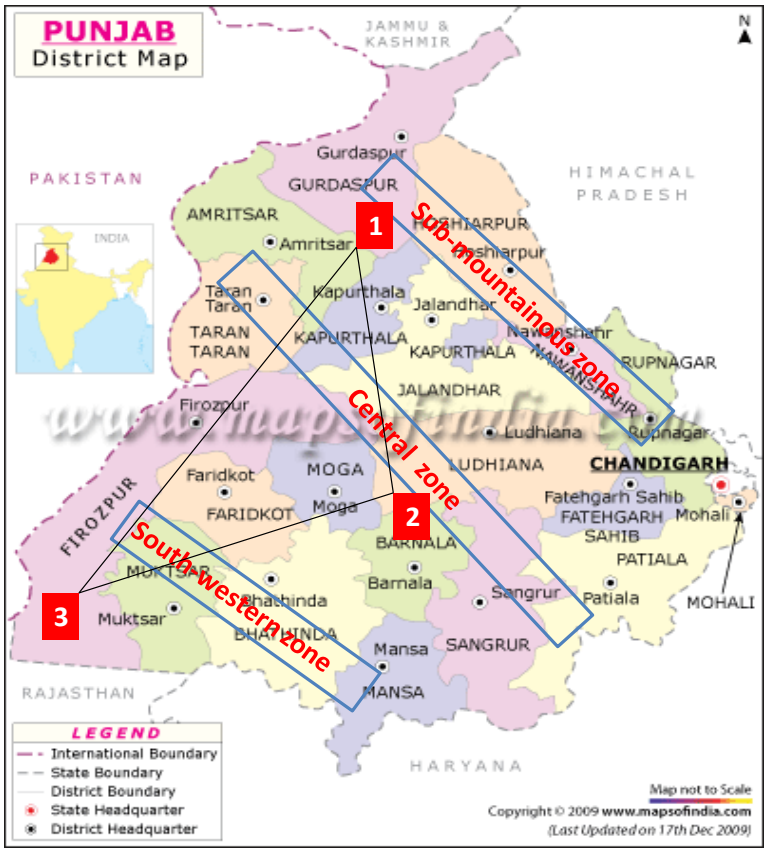
Farmers were selected using multistage cluster and purposive techniques in combination. To start with, a Farming Intensity Index (FII) was calculated using the key indicators of agricultural sustainability i.e. per hectare agricultural production in value terms, condition of the underground water table, state of soil health and crop-diversification index,. The FFI was then used to select districts and then blocks[5] using multistage cluster sampling technique. Then two heterogeneous villages[6] from each block were selected in consultation with the extension workers of the district and block concerned through a group discussion using the same indicators of agricultural sustainability which were used to select districts and blocks to maintain the consistency. After selecting the villages, a list of 20 farmers (Marginal-3; Small-3; Semi-medium-6; Medium-6; and

[5] Due to non-availability of production data at block level, the other three indicators of agricultural sustainability were used for the selection of blocks.

[6] Since two villages were to be selected so they should be heterogeneous to cover the extremes.

Large-2)[7] in each village was prepared in consultation[8] with the extension workers of the block concerned on the basis of the current landholding distribution in Punjab. On an average, each interview took about 90 minutes including recording quantitative data about cropping systems, cost of cultivation and net profitability. The interviews were conducted in Punjabi, the native language of Punjab, at the village community centre/house of village head.

**Figure 4: District-wise political map of Indian Punjab showing three agro-climatic zones and the districts chosen for study, Gusdaspur 1, Barnala 2 and Ferozpur 3**




Source: www.mapofindia.com (accessed January 2011)

## Results

A farmer in Punjab has an average land holding of 4.01 ha, which is three times more than the national level at 1.33 ha (GoPb, 2009). Out of the 120 farmers surveyed across six villages:

- 60% owned more than 4 ha of land.
- Average operational land holding of 5.73 ha.

[7] The current landholding distribution in Punjab is: Marginal (less than 1 ha)-13.42%; Small (1-2 ha)-18.22%; Semi-medium (2-4 ha)-31.85%; Medium (4-10 ha)-29.45%; and Large (more than 10 ha)-7.06% (GOP, 2010).

[8] The researcher understands the element of biasness, but this was the best method of selection under the given circumstances and resources.

- More than 92% of farmers are engaged in farming on full time basis.
- About 88% of the farmers were aged between 26 and 65 years.
- Only 1 percent of farmers were between 16 and 25 years of age
- 11% were more than 65 year old

Interestingly, despite Punjab being one of the economically and educationally advanced states of India, 12% of the total farmers surveyed could not read or write and 67% had only been in full-time educational up to age 14 years Only 6% and 4% were graduates and post-graduates respectively. Only 13 percent have farming experience of less than 10 years compared to 69% who have more than 15 years experience. More than 80% of farmers had basic amenities like a bicycle, two-wheelers (scooter, motorcycles), TV, refrigerator, and cooking gas. More than 40% own a four-wheel vehicle and 88% farmers have mobile phones.

Around 88% of farmers earmark 0.55 ha and 0.44 to green fodder in both Rabi and Kharif[9] seasons to feed their domestic livestock mainly buffaloes (81%) and cows (42%). Only 33% have oxen which are used mainly to carry green fodder home and farm inputs to farm. For major farm operations, more than 65% of farmers have tractors and more than 40% have other farm implements like cultivators, leveller, disc and trolleys. More than 55% farmers own diesel engines and 38% own generator sets installed at their farms to pump out water from the water table mainly for rice cultivation since electric supply remains erratic in the countryside during summers, the rice cultivation season.

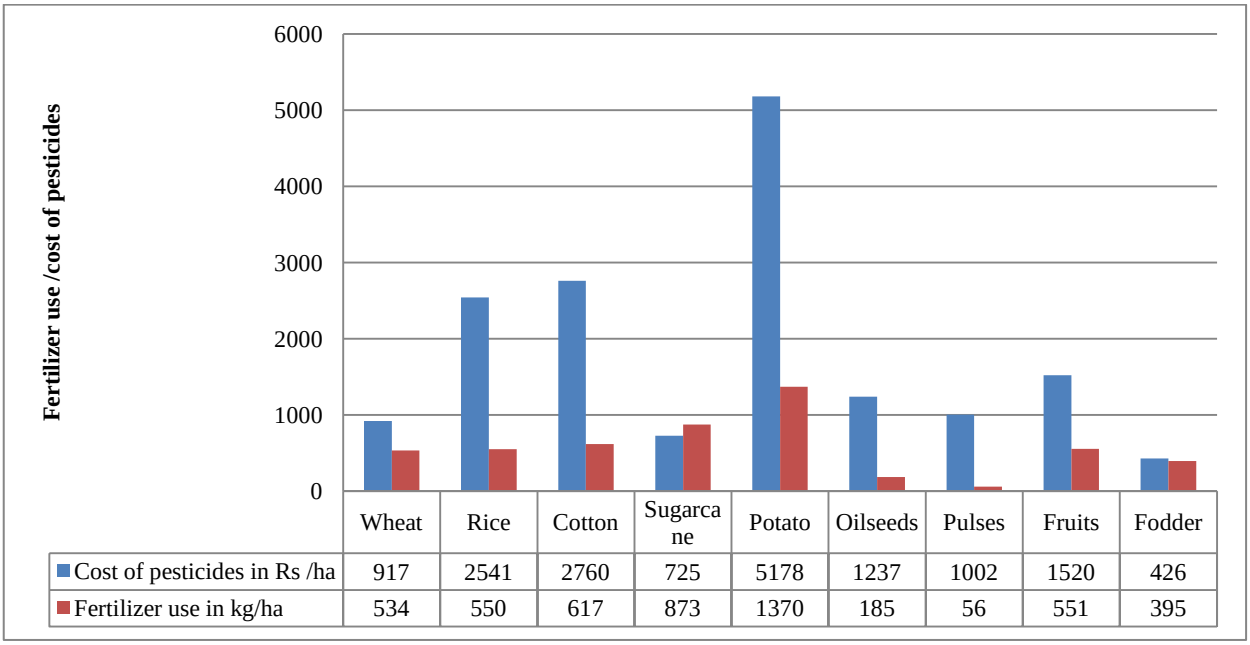
Despite the state government's claims regarding credit facilities at village level, only 15% of farmers have access to Kisan (farmer) cards. Around 67% farmers have an account with Primary Agricultural Cooperative Society (PACS) that operates in almost all villages of Punjab and provides easy term loans to farmers. It also provides major farm inputs to farmers at controlled prices. About 57% of the farmers use only underground water resources to irrigate their crops whereas only 9% have access to canal water and 42% use both sources of irrigation. Most of the farmers, who grow rice use tube wells to pump underground water.

Of the 688 ha of land cultivated by the 120 farmers, about 81% and 73% of land was under wheat and rice respectively followed by cotton (13%), green fodder (7%) and sugarcane (3%). Out of the 120 farm households, wheat, being a staple diet in Punjab, was grown by all and 105 households were engaged in rice cultivation which illustrates the WRCP as the dominant cropping pattern in Punjab. Around 75% (27 out of 36 total marginal and small farmers surveyed) farmers, who mostly hire farming machinery for cultivation, grow rice only because of its assured marketing

[9] Rabi season is between November to April and the Kharif season is between May to October

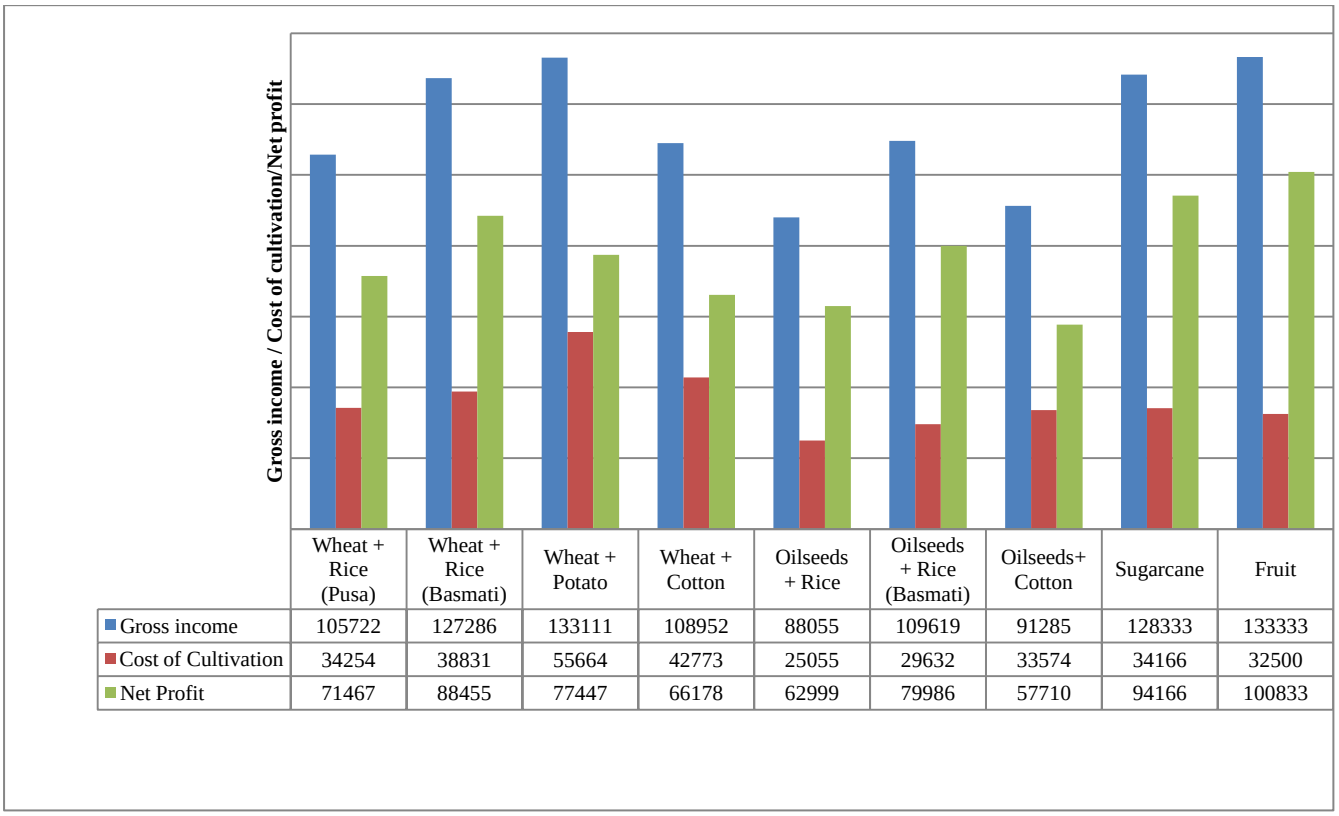
(MSP and purchase) and stable yield rates. The average fertilizer use per hectare for wheat and rice was around 534 and 550 kgs respectively compared to 1370, 873, 617 kgs for potato, sugarcane and cotton which are considered as the close substitutes to rice (Figure 5).

**Figure 5: Average fertilizer usage (in kg/ha) and cost of pesticides (in Rs/ha) for major crops**




| | Wheat | Rice | Cotton | Sugarcane | Potato | Oilseeds | Pulses | Fruits | Fodder |
|---|---|---|---|---|---|---|---|---|---|
| Cost of pesticides in Rs /ha | 917 | 2541 | 2760 | 725 | 5178 | 1237 | 1002 | 1520 | 426 |
| Fertilizer use in kg/ha | 534 | 550 | 617 | 873 | 1370 | 185 | 56 | 551 | 395 |

**Figure 6: Gross income, cost of cultivation and net profitability of major cropping patterns**




| | Wheat + Rice (Pusa) | Wheat + Rice (Basmati) | Wheat + Potato | Wheat + Cotton | Oilseeds + Rice | Oilseeds + Rice (Basmati) | Oilseeds+ Cotton | Sugarcane | Fruit |
|---|---|---|---|---|---|---|---|---|---|
| Gross income | 105722 | 127286 | 133111 | 108952 | 88055 | 109619 | 91285 | 128333 | 133333 |
| Cost of Cultivation | 34254 | 38831 | 55664 | 42773 | 25055 | 29632 | 33574 | 34166 | 32500 |
| Net Profit | 71467 | 88455 | 77447 | 66178 | 62999 | 79986 | 57710 | 94166 | 100833 |

The data (Figure 6) illustrates that gross income (MSPs multiplied with average yields) and net profit was highest for fruit production, although this commodity has very limited marketing infrastructure in Punjab. The wheat-potato combination gives good gross income but due to its high cost of cultivation, especially fertilizer and pesticide inputs (Figure 5), net profit is lower. Sugarcane even as an annual crop has a reasonable net profit due to its low cost of cultivation, especially cost of fertilizer and pesticides (Figure 5). The third best combination is wheat-rice (basmati), due to its lower costs of cultivation than wheat-potato and wheat-cotton combination. Net profit from wheat-rice (Pusa) combination is higher than the wheat-potato and wheat-cotton crop combinations (Figure 6). Wheat-cotton yields less profit due to high cost of cultivation and price instability of cotton (see Table 2). Even oilseeds-rice (basmati) yields good returns due to comparatively lower cost of cultivation but wheat, being a staple diet of people in Punjab, is grown by every farmer so oilseeds cannot replace wheat so easily.

**Discussion**

Agriculture in Punjab is characterised by relatively small intensive land holdings, the majority of which have low cropping diversity and relatively high cropping intensity. This is illustrated by the yields achieved, particularly in relation to the main crops, wheat (3961 kg/ha) and rice (6770 kg/ha-pusa; 4719 kg/ha-basmati). These high levels of productivity suggest that Punjab agriculture is financially viable, although the intensity of farming and in particular the use of pesticides, fertiliser and water have led to serious concerns about the sustainability of farming systems (Chand, 1999; Sidhu, et al., 2010). Survey data illustrates the high uses of these resources such as chemical fertilizers (NPK-506 kg/ha as compared to 117 kg/ha at India level in 2007-08 and 34 kg/ha at world level in 2005-06).

Like many farming communities, Punjab is characterised by an ageing farmer population, with fewer young entrants. Only 1% of the total farmers surveyed were found in 16-25 year age group. This phenomenon may limit the scope of innovation and adoption of modern methods of sustainable agriculture limited. Aged farmers, although experienced, are often less well-educated, and are often resistant to change are risk averse. In many communities there is little employment other than farming and many farmers do not have the skills to work in other sectors, thus most farmers are engaged in farming on a full-time basis which can limit their ability to think more widely. This is borne out by the survey that suggests the majority of farmers are full time.

With more than 1 million tube wells and about 0.4 million tractors, agriculture in Punjab is highly capitalized which can reduce the versatility of farmers, “locking” them into certain production systems. Despite the high productivity of Punjab systems, about 20% of the farmers in Punjab

were living below poverty line income in 1999 (Chand, 1999) and about 65% are in debt of an average amount of Rs 41.576 (NSSO, 2005). The average annual net income from wheat and rice which is most widely sown is Rs 71, 467 which is less than an annual salary of a newly appointed clerk.

Moreover, farming, as a profession, is not attractive enough for young people in Punjab where unemployment is becoming a problem (Sidhu, 2002). Rice cultivation, particularly using puddling[10] and flood irrigation is believed to be the main reason for underground water table depletion in central Punjab, the main rice growing area. Moreover, application of more chemical fertilizers and pesticides to maintain yield rates of wheat and rice increases the cost of cultivation on the one hand and gradually deteriorates soil health, which in turn makes it more difficult to maintain yields. Therefore, there is an urgent need to disseminate resource conservation technologies like laser levellers, tensio-meter, zero-tillage and direct seeding of rice. Basmati rice cultivation, which is currently limited to some pockets in Punjab, appears to have potential because it requires less water and other farm inputs especially fertilizers when compared to pusa rice, a widely sown variety of paddy rice. But in the absence of marketing support (fixed price and purchase) for basmati rice from the central government, farmers, who are already debt-ridden (NSSO, 2005) don't have enough risk bearing capacity to venture into basmati rice cultivation. Basmati rice has latent market potential for export to European countries which can be explored with the inclusion of rice varieties such as Sugandha, Sharbati, Pepsi and 999 which are produced in Punjab in the list of varieties allowed for exports.

Farmers, being more concerned to sustain their livelihoods than any ecological considerations, consider the economic aspect of sustainability as the most important criteria while selecting a cropping pattern for themselves. The Wheat Rice Cropping Pattern, under the given set of marketing and productivity parameters, has been and continues to give them the best returns to sustain their livelihoods.

## Conclusion

Evidence suggests that farmers continue with the WRCP because, despite serious sustainability concerns from policymakers, NGOs and academics, these systems can produce reasonable financial income with relatively low risk. The empirical studies (Chand, 1999; World Bank, 2003; Shergill, 2007) and the research findings presented here show that WRCP, under the present set of marketing infrastructure and agricultural technological know-how, is likely to produce the

[10] Puddling is done to make the upper surface of the land harder enough to keep the water stand in the field) the land for rice cultivation which helps apply weedicides to control weeds

highest and more stable incomes for Punjab agriculture in the short term. The lack of marketing infrastructure for crops other than wheat and rice may also help to explain the concentration on WRCP and a reluctance to try new cropping systems.

However, the research and development agenda needs to be strengthened in terms of concentrating on reducing the cost of cultivation and water usage in addition to dissemination of the findings among farmers through well-planned networks of extension services. Moreover, tailor made courses on sustainable agriculture can be started for young and middle-aged farmers which help them understand the basics of sustainable farming. If the longer term sustainability of agricultural systems in the Punjab is to be secured then it is likely that farmers need to receive encouragement to switch toward diverse and perhaps less intensive systems. Mechanisms that could help with this process include:

1. Encourage the growing of new crops as happened in Gujarat where cotton, pulses, fruits, vegetables and livestock registered very handsome growth rates with overall agricultural growth rate of 9.6% during 2000-01 and 2006-07 (Shah et al., 2009).
2. Better knowledge of input use in terms of fertiliser, pesticides and water through introducing soil health cards and rain water harvesting techniques as in Gujarat agriculture (Shah et al., 2009).
3. The development of new markets for alternative crops such as tapping the export potential of basmati rice and fruits, especially kinnow, a variety of citrus grown in south-western part of Punjab.
4. Encourage agro-processing units in the rural areas such as processing of wheat, grapes, sugarcane and milk.

Policymakers could encourage such changes by, for instance, putting in place better education and extension opportunities for farmers, changing the subsidy regimes related to farm inputs and by helping to encourage new marketing infrastructures.

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